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CONTRACT NO. A032-129
FINAL REPORT
JUNE 1992

Sierra Cooperative Ozone Impact Study: Year 2 - Volume 1

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY



AIR RESOURCES BOARD
Research Division

SIERRA COOPERATIVE OZONE IMPACT STUDY: YEAR 2

Volume I

**Final Report
Contract No. A032-129**

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ABSTRACT:

The purpose of the Sierra Cooperative Ozone Impact Assessment Study (SCOIAS) is to document the degree to which sensitive pine species in Sierran forests are exposed to ozone and the amount of damage the exposed trees exhibit. The major cooperators are the U.S. Forest Service (USFS), the California Air Resources Board (ARB) and the University of California, Davis (UCD). This document reports progress made by the UCD cooperators during the second year of the project (June 7, 1991 to June 6, 1992). The major tasks performed were the continued operation of the five sites established in the first year's effort, the installation and operation of a sixth site and data quality control, analysis and archiving. The five stations established in 1990 are Mountain Home within the Sequoia, Jerseydale in the Sierra, Five-Mile Learning Center in the Stanislaus, Sly Park Learning Center in the El Dorado and White Cloud in the Tahoe National Forests. The sixth site was installed at Shaver Lake in the Sierra National Forest and was activated on July 24, 1991. Instrumentation to measure solar radiation was added to all sites between August 28 and September 19, 1991. The ozone monitoring season is the warm part of the year, from about April 15 to October 15, although actual station operating dates depend on accessibility in the spring. At all but one site, the targeted 80% data coverage was attained or exceeded. At one site a combination of computer system problems and ozone monitor malfunctions caused data voids totaling 22% of the operational period. These problems appear to have been solved by mid-season. Measured ozone concentrations are typically highest in the afternoon hours, and tend to increase toward the southern end of the network. Stations located on well defined steep slopes show a very strong diurnal variation in ozone concentration and meteorological conditions. Hourly peak ozone concentrations from June through September are greater than 60 ppbv at all sites nearly every day, in excess of 80 ppbv at most sites more than half the days and in excess of 100 ppbv at least several days a month at all sites and nearly half the days at the most impacted site (Mountain Home).

ACKNOWLEDGEMENTS:

We gratefully acknowledge the high level of cooperation and enthusiasm from the personnel at all the sites. The professional contributions of R.O. Judkins and A.J. Dixon of UCD and the assistance of graduate students M. Liu and J. Davis are gratefully acknowledged. This report was submitted in fulfillment of ARB-UCD Interagency Agreement # A032-129, Sierra Cooperative Ozone Impact Assessment Study, by University of California, Davis under the partial sponsorship of the California Air Resources Board. Work was completed as of 6/6/92.

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DISCLAIMER:

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products.

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SUMMARY AND CONCLUSIONS:

The purpose of the Sierra Cooperative Ozone Impact Assessment Study (SCOIAS) is to document the degree to which sensitive pine species in Sierran forests are exposed to ozone, the meteorological processes that produce high ozone concentrations and the amount of damage the exposed trees exhibit. The major cooperators are the U.S. Forest Service (USFS), the California Air Resources Board (ARB) and the University of California, Davis (UCD). This document reports progress made by the UCD cooperators during the second year of the project (June 7, 1991 to June 6, 1992). The primary tasks pursued were the continued operation of the five measurement sites established in 1990, installation and operation of a sixth site (Shaver Lake), retrieval of the instrumentation in late fall, maintenance and re-calibration of these over the winter and reinstallation and operation of the stations as they became accessible in the spring. The USFS cooperators have conducted training classes (July, 1991) and begun scoring of ozone damage in plots of pine trees located near the monitoring sites.

The six sites were originally selected to satisfy both the needs of the biological effects researchers and meet the meteorological criteria necessary to characterize exposure of pine species to ozone in the immediate vicinity of the sites (Carroll, 1991). The sites range in elevation between 3750 and 6200 feet above mean sea level. Measurements of ozone concentration (differential UV absorption) and meteorological conditions (temperature, humidity, wind speed and wind direction) are recorded with a PC-based data acquisition system. The system also monitors several additional variables such as the A/D reference voltage and enclosure temperature. Between August 28 and September 19, solar radiation measurements were added to the systems. The stations are visited by project personnel approximately biweekly at which time instrument maintenance is performed, as necessary, and the recorded data retrieved via diskette. Two stations, located at learning centers, are operated year round except for a short period in winter used for maintenance and re-calibration. Although this exceeds the contract requirements, these stations are used by the learning centers as part of their educational program and this use is part of our agreements with them. The remaining four are deactivated in late fall and reinstalled beginning in mid-April as the sites become physically accessible.

Quality assurance and quality control are performed both by us and by a subcontractor from San Jose State University (SJSU). UCD maintains transfer standards for ozone, temperature and humidity and performs periodic checks of the

RECOMMENDATIONS:

While the primary measurements described here are sufficient to document environmental conditions and ambient exposures, the actual dosage received by the trees is not defined. Evidence in the literature suggests that damage to plant tissues is due to the flux of ozone into the leaves (Coyne and Bingham, 1981; Yang et al., 1983). While we can document external exposure, the real issue appears to be the flux of ozone into the leaves, i.e., the product of the external ozone concentration times the stomatal conductance. Stomatal conductance is in turn a function of air temperature, humidity and the available sunlight. Davis (1992) has developed a method for estimating stomatal conductance for pine species using environmental data such as those measured at our sites. We recommend that dosages be calculated based on hourly estimated stomatal conductance and hourly ozone concentrations as these estimates should better describe the potential for ozone injury than the ambient ozone concentration alone.

The striking differences in the diurnal pattern of ozone concentrations between Jerseydale and Five-Mile Learning Center and the other stations needs further study. As the data base expands into the second observational period, the repeatability and detailed nature of these differences should be examined more carefully.

The differences in the diurnal pattern among sites raises questions about spatial variability and the nature of three dimensional pollutant transport. Observations frequently show strong layering of ozone in the vertical, with elevated layers of high ozone concentrations (> 80 ppbv) persisting through the night. These layers can impact the slopes of major topographic features. Given the complexity of the topography at and near the sites under study, we strongly recommend that portable ground unit(s) and aircraft borne systems be used to supplement the fixed site measurements and assess whether three dimensional spatial variability is significant in these areas. The airborne observations are also needed to assess the three dimensional transport issues.

INTRODUCTION:

It has been established in laboratory conditions that ponderosa and Jeffrey pines are susceptible to damage when exposed to ozone. Ozone affects various parts of

wind sensors. Based on these calibration checks and other data recorded in the monitoring systems and from field logs, data quality information is encoded into the archived records. In addition, the SJSU subcontractors have performed three independent audits of each of the stations and have the ozone transfer standard checked yearly by the Standards Laboratory of the ARB.

All of the major objectives have been met -- with the exception of 80% data recovery at all sites. At Mountain Home, data were lost for a period representing 22% of the observing season due to a series problems with the computer systems installed there. Systematic problems with the ozone monitors at several sites caused the loss of up to 19% of ozone data at two sites. All of these problems appear to have been successfully resolved by mid-season.

Available literature indicates that needle damage occurs from exposure to ozone concentrations of 60 ppbv, and is significant at and above 80 ppbv (e.g., Hogsett et al., 1985; Miller and Millecan, 1971; Skarby et al., 1987; Williams et al., 1977; Woodman, 1987). The recorded data suggest that serious to severe exposure (> 80 ppbv) of pines to ozone is likely. The data show that ozone concentrations are typically highest in the afternoon hours, and tend to increase toward the southern end of the network. Stations located on well defined steep slopes show a very strong diurnal variation in ozone concentrations and meteorological conditions. Hourly peak ozone concentrations from June through September are greater than 60 ppbv at all sites nearly every day, in excess of 80 ppbv at most sites more than half the days and in excess of 100 ppbv at least several days a month at all sites and nearly half the days at the most impacted site (Mountain Home). At the two sites in the middle of the network (Jerseydale and Five-Mile Learning Center) the diurnal variations in ozone is least well pronounced and nighttime values remain relatively high. It is not clear at this writing whether this is due to the fact that these two sites are surrounded by relatively flat topography or whether this is due to differences in regional transport patterns and their distance from primary emissions areas.

The stations at the southern end of the network appear to have higher peak ozone concentrations than those in the north. This latitudinal gradient may also be a result of altitude differences among the sites. The southernmost site is also the highest elevation site. It is also not clear whether these observations are due to the trapping of pollutants within or between inversion layers that intersect the slopes, due to the net accumulation of pollutants as the air traverses the San Joaquin Valley before turning up slope or due to higher emission rates of primary pollutants in the southern part of the Valley.

INSTRUMENTATION:

The list of currently recorded variables is contained in Table 2. The initial set of sensors were the wind systems mounted at the top of the towers and the temperature and relative humidity sensors mounted about two meters above the surface. The ozone monitors are located with the data acquisition equipment in weather protected environments. Input to the monitors is through 0.25 inch diameter teflon tubes mounted outdoors, two to three meters aboveground and at least 0.5 meters from extended surfaces such as roofs or walls. Photometric light sensors sensitive to solar radiation were installed at the top of the each instrument tower between August 28 and September 19, 1991. These instruments have been added to measure solar radiation reaching the trees. This, in addition to the air temperature and humidity data, is needed to estimate stomatal conductance and ozone uptake by the trees.

All instruments are calibrated in-house through the data acquisition systems used in the field. The wind speed sensors were calibrated using fixed RPM synchronous motor calibrators corresponding to two wind speeds. Their starting thresholds and the resistance of the wind direction sensors were checked using a torque watch. The temperature sensors were checked using a secondary standard, liquid in glass thermometer. The humidity sensors are calibrated in the laboratory with a high quality dew point hygrometer and a psychrometer. An electronic temperature and humidity transfer standard is used for in situ calibration checks during the monitoring season. The ozone monitors are calibrated in the laboratory and in situ using both their internal self-checks and by use of an ozone calibrator/transfer standard. These checks along with cleaning and filter changes are part of the routine maintenance procedures.

SOFTWARE DEVELOPMENT AND DATA HANDLING:

Flexible, user friendly, data acquisition software was developed at UCD. The program allows listing of recent data (the last 12 five minute averages or the last 16 hourly averages) to the screen at the sites with no interruption of the data acquisition function. This allows convenient access to these data by on-site personnel as well as by our service technicians. The software has error trapping capabilities and restarts itself following power failures as well as following miscues or unauthorized keyboard requests. The output of the data acquisition system consists of three types of files. The first contains five minute averages of the data sampled at one second intervals and the standard deviation of these

the plant adversely, including specific forms of needle damage observable at the end of a growing season. Chronic exposure and the accompanying damage and stress is believed to be a major threat to the viability of forests in California, including those along the western slopes of the Sierras. The U.S. Forest Service, U.C. Davis and the ARB have established a cooperative study to document ozone exposure and any accompanying damage to selected stands of trees as a means of assessing the impact of ozone on naturally growing trees. The measurement of local concentrations of ozone and meteorological conditions near these stands of trees is the responsibility of the U.C. Davis group, and is the subject of this report.

During the summer and fall of 1990, a network of five stations was installed along the foothills of the Sierra Nevada. A sixth station was installed at Shaver Lake in July of 1991. The locations of the sites are shown in Figure 1, with additional information, including dates of operation listed in Table 1. The first five stations were operated in the fall of 1990 and were reinstalled in the spring of 1991 to begin the first full year's operation. Since the observable damage is cumulative, a key requirement of the measurement systems is that they be fully operational at least 80% of the duration of the growing season, which lasts from late April until the end of September. Beginning in late summer, Forest Service employees and other cooperators, not funded by this project, quantitatively score ozone specific needle damage, if any, and record other information on the health and vitality of the selected groups of trees located near each of our sites.

When the current funding began on June 7, 1991, all but the Shaver Lake site were in full operation. Permission to use this site was secured by the end of June and the site became operational on July 24, 1991. The instrumentation at the two Learning Centers (Five-Mile and Sly Park) is operated through the winter in support of educational programs given at those locations in accordance with our agreements with the school districts. However, data recovery and quality control procedures are somewhat relaxed during the winter periods. Instrumentation from all sites is withdrawn and refurbished prior to the start of the primary data acquisition season.

In addition to the operational tasks required to run the network, the project Staff Research Assistant and one graduate student attended the meeting lead by Judy Rocchio held in July to familiarize cooperators with the damage assessment problems. They also attended training sessions on how to assess tree vitality and identify and score ozone specific needle damage.

of applicability. Finally, we keep a MASTER BINDER at UCD in which we place instrument calibration summaries and results, printouts of station on-line log files, time plots of raw data for multi-day periods, and summaries of significant events transcribed from the STATION LOG. This binder contains explanations of QCW non-zero values added to the archived data sets. The binder also contains tables of the event roses averaged by time of day over multi-day periods of time.

SUB-CONTRACTOR ACTIVITY:

The primary functions of the Subcontractor at San Jose State University were to provide independent quality assurance audits, to develop a separate data archive and tabulated summaries of hourly data, and to arrange for the certification of the transfer standard. A summary of their activity is contained in the appendix.

The subcontractors conducted three field audits (July 8-12, August 6-8, and October 17-19, 1991). The results of these audits were all very positive with no calibration disparities or other problems identified. Calibrations of all instruments have remained constant except for the ozone monitors. These have shown small changes in the slope of their responses, but all remain within 6% of the calibrations established at the start of the season. The data processing programs apply the small observed corrections to the ozone calibrations as well as the 9 ppbv offset deliberately set into the units' outputs.

INSTRUMENTATION PERFORMANCE:

The instrumentation performance is summarized in Table 5 for the primary observation period ending October 15, 1991. The information is given in terms of the percent of the available hours during which data were lost. These statistics are subdivided in terms of which part of the system failed. At all but one station we were able to achieve the targeted 80% data recovery. The computer problems at Mountain Home were complex and were only solved (in August) by replacing all of the internal boards in the computer. The cost for this repair were borne primarily by the supplier. The problem with the Five-Mile system was never resolved, it simply went away. The difficulties with the ozone monitors at Five-Mile and part of the time at Jerseydale were due to instruments' automatic shut down when the UV source exceeded its saturation count. Once this problem was identified, with assistance from the manufacturer, we modified our maintenance procedures and the problem was not encountered again. The ozone monitor failures

data. The second contains a joint distribution table of the number of observations and the average of each variable by octant of wind direction. The third type of file is a log file in which automatic and manual entries can be made describing significant events related to the data logging function such as restarts after power interruptions, use of user interactive features (hot keys) and the like. The format of these files is shown in Table 3. These data are copied onto diskettes for transfer to UCD. The last data copied to the diskette is also saved in a backup directory on the on-site system's hard disk and not deleted until the retrieved raw data has been successfully reduced. The data acquisition program also writes pertinent information to a log file which keeps track of various types of activities on the system.

Data acquired at the sites are processed at UCD using the procedures outlined in Figure 8. Data quality control is assessed from scanning the data themselves, log book entries, interpretation of the on-site log files and from the periodic calibration checks. The raw data are transferred to a permanent archive which includes a data quality word, as described below. The archive includes both the five minute data and the hourly, event-rose summaries. Each data record or set of records is marked by a data quality word. This word is set up so that each digit represents the data quality code for a particular instrument, as shown in Table 4. For example, if we had seven instruments, there would be seven digits in the quality control word (QCW). For the five minute data and its derivatives, we have one QCW per record. For the event data we will have one QCW per grouped record. For the event data, if an instrument malfunctions for any part of the time, we flag the whole period with the most critical code for that instrument. In addition to the data files themselves, summaries of the data quality assessments are kept as individual files at UCD. In fact, these are created as input files for the programs that create the archive files which include the appropriate quality control words.

PRIMARY RECORD KEEPING:

We have several written records of operating procedures, instrument use, and calibration histories. One is the TRAVELING LOG, in which we record information on site visits, problems encountered, maintenance performed and other pertinent information. At each station is a STATION LOG in which we, the SJSU auditors and on site personnel make entries. The STATION LOG contains a detailed operational history, records of instruments in use (by serial number), calibration data, repair and maintenance data, systematic corrections made to the data and periods

Ozone concentrations remained relatively high at most stations through the middle of October. Clearly the weather changed following a stormy period which began on the 21st of October. After that date, ozone concentrations at all stations, except Shaver Lake, remained below 60 ppbv. At Shaver Lake, 70 ppbv was reached on October 23 and 24.

The frequency distribution of the hourly ozone concentrations, expressed in terms of percent of available data by month for each station, is listed in Table 6. The same data are plotted in Figure 15 comparing the percent occurrence of concentration ranges among the six sites each month. Note that the Shaver Lake data are only for the last 5 days of July, when ozone concentrations were high throughout the network. There are several patterns discernable in Table 6. The first is that higher concentrations are more likely near the southern end of the network than at the northern or central part. The second is that at all sites, the occurrence of higher concentrations increased as the season progressed. Since the air reaching the southern Sierras has a long fetch through the San Joaquin Valley (which contains an number of urban areas and transportation corridors), we expect that the latitudinal differences are representative and likely to occur every year. The increase in concentration in late summer may not be representative in that the first half of the summer of 1991 was relatively cool in central California, indicating that this may be an atypical pattern.

Clearly, several of the sites experience ozone concentrations that can be injurious to vegetation. What is somewhat surprising is that in some cases, ozone concentrations remained high at night, even with downslope flows. There are many possible explanations for these observations but selecting among them at this point would be purely speculative.

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at Sly Park and the remainder of the time at Jerseydale were due to failures of the display boards. We have instituted preventative measures to alleviate this problem, which have been fruitful, at least through the end of October. We have gained valuable experience with the ozone analyzers and are confident that we will improve data recovery rates and data continuity in the future.

The last column of the table lists the percent of the time that the instrument enclosure temperature exceeded 30 °C, the value at which the US EPA warns that the accuracy of the measured ozone concentration may be compromised. Tests of these systems in our laboratory to temperatures of 45 °C showed no dependence of the calibration slope or zero on the measuring unit's temperature. However, given the concerns expressed by the EPA, we are planning to install air conditioning units at the warmer sites next season.

MONITORING RESULTS:

Hourly averaged data for each site, for the months of May through November, are plotted in Figures 9-13. Tabulated hourly data are contained in the appendix. The typical diurnal pattern of up slope (westerly) winds during the daytime hours and downslope (easterly) winds at night is quite apparent at Mountain Home, Shaver Lake and Sly Park. The diurnal variations in the meteorological variables are moderately well defined at Jerseydale and Five-Mile but not very apparent in the ozone data. At White Cloud, only air temperature shows a well defined diurnal pattern. While there are differences among stations, peak ozone concentrations usually occur in the afternoon hours when the upslope flows are well established, winds are strongest and the temperatures are the highest. Miller (private communication) has suggested that stomatal closure occurs in pines at temperatures comparable to the warmer afternoon temperatures observed at the sites. If this is true, then the actual dosages received by the trees may be considerably less than might be expected from the high concentrations seen in the data.

Nighttime minima in ozone concentrations are also different among the stations. Shaver Lake and Sly Park typically drop the most at night, frequently reaching minima of 20 ppbv. Conversely, the other sites frequently have nighttime minima in excess of 60 ppbv. Again, whether this pattern is representative of other years remains to be seen. However, it appears regularly enough to suggest that these differences represent the net effect of the variability in a number of factors that control ozone transport, formation and destruction.

TABLE 1
SIERRA OZONE ASSESSMENT SITE CHARACTERISTICS

NO.	NAME	NATIONAL FOREST	ELEV. (FEET)	COOPER- ATOR	WIND TOWER HEIGHT	OPERATING DATES
1.	MT. HOME	SEQUOIA	6200	CDF	17m (56')	10/10-11/12/90 5/25-11/07/91 5/14/92-pres.
2.	SHAVER LK.	SIERRA	6000	SCE	12m (40')	7/24-11/08/91 5/13/92-pres.
3.	JERSEYDALE	SIERRA	3750	USFS	17m (56')	9/21-12/18/90 5/09-11/08/91 4/23/92-pres.
4.	5-MILE LEARN- ING CENTER	STANIS- LAUS	4000	CLOVIS SCH. DISTRICT	12m (40')	12/05/90-pres.
5.	SLY PARK	EL DORADO	4200	SACRA. SCH. DISTRICT	17m (56')	10/30/90-pres.
6.	WHITE CLOUD	TAHOE	4350	USFS	12m (40')	9/26-11/28/90 4/23-11/14/91 4/27/92-pres.

TABLE 2
INSTRUMENT AND EQUIPMENT VENDORS:

Vendor	Equipment	Model
Met-One	Temperature, Humidity Wind Speed Wind Direction	083-1,1760TS-1760G 014-1,1680-1812 024-1,1690-2106
DASIBI	Ozone Monitor Ozone Calibrator	1008 AH 1008 PC
LI-COR	Solar Radiation	200-SZ
DCL Computers	Data acquisition	DFID11XT
Tri-Ex Tower Corp,	50' Telescoping Tower 33' Telescoping Tower	W7-51 MW-33
Keithly/Metrabyte	8 channel MUX-A/D	STA-8PGA

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TABLE 3 (CONTINUED)

ARCHIVED FIVE MINUTE AVERAGE FILES:

-- Date (julian day), year, number of records, station
 -- Time, Ave (DD,FF,u,v,Ta,RH,O,S), RMS (DD,FF,u,v,Ta,RH,O,S), QCW

UP TO 24 HOURS WORTH

ARCHIVED HOURLY EVENT DATA:

-- Julian day, year, station, number of data blocks.

--	Decimal hour, and QCW for the hour.
--	# of observations by wind direction.
--	Average wind speed "
--	Average humidity "
--	Average temperature "
--	Average ozone "

Repeat for each hour of
the day for which data
are available.

TABLE 4
SCOIAS DATA QUALITY CODES.

The values for the codes are as follows:

- 0 No known problems. Calibration corrections have been applied. Data should be fine.
- 1 No calibration corrections have been applied or no calibration correction available.
- 2 Systematic error adjustments applied or data corrected for noisy signal.
- 3 Data not representative, non-standard exposure (test).
- 4 Data not representative, cold start/warm up period.
- 5 Data questionable, malfunction suspected.
- 6 Data is no good, instrument malfunction.
- 7 Data is no good, instrument not connected or inoperative.
- 8 Used for TBOX only, means shelter temperature is outside EPA specified limits for the DASIBI monitors.
- 9 N/A

Digit:	1	2	3	4	5	6	7
QCW =	S	DD	FF	RH	TEMP.	OZONE	TBOX

NOTE: Due to instrument warmup requirements, ozone data are flagged "4" for one-half hour following restarting after a power failure.

TABLE 3
DATA FILE STRUCTURES:

Definitions:

DD = Wind direction	FF = Wind speed
RH = Relative humidity	Ta = Temperature
O ₃ = Ozone concentration	Tb = Enclosure temperature
v = South to north wind component	u = West to east wind component
S = Solar radiation	R = Reference 5 volts

LOG FILES:

- Date and time of program restarts (e.g. after operational maintenance, or power failures); of data acquisition interruptions due to use of "hot keys"; counts of instrument's error flag and manually entered notes.
-

ON-LINE FIVE MINUTE FILES

- Month, day, year, hour, minute, station number
- Number of obs., DD, FF, u, v, Ta, RH, O₃, Tb, S, R
Rms {DD, FF, u, v, Ta, RH, O₃, Tb, S, R}

Twelve entries per hour, 24 hours per day. Data appended to these files every five minutes.

ON-LINE HOURLY SUMMARY WIND & EVENT FILES:

- Month, day, year, hour, minute, station number
- Event distribution by octants in the wind direction:

Wind Dir. (Deg.)	Number of Obs. (count)	Average FF (m/s)	Average RH (%)	Average Ta (°C)	Average O ₃ (ppbv)
CALM	71	0.0	42	12.5	55
22.6 - 67.5	1647	1.9	38	13.6	59
67.5 - 112.5	1231	1.6	38	13.5	59
.
.
.
292.6 - 337.5	36	1.9	37	13.5	57
337.6 - 22.5	179	1.8	38	13.6	58

Table 6
Percent of hourly average ozone concentrations by month (1991)
and station for concentration ranges shown.

Month	Ozone Concentrations (ppbv)								
	< 50	50-59	60-69	70-79	80-89	90-99	100-109	110-119	> 119
MOUNTAIN HOME:									
May	38.2	10.5	30.3	11.8	6.6	2.6	0.0	0.0	0.0
June	3.9	8.6	18.2	23.3	22.1	12.3	7.6	3.9	0.0
July	11.9	10.7	16.4	19.7	17.6	14.3	5.1	3.6	0.6
August	29.8	16.5	18.3	14.5	9.8	7.7	3.3	0.2	0.0
September	25.3	13.4	14.7	14.1	11.7	9.1	6.8	3.3	1.6
SHAVER LAKE:									
July ¹	42.0	6.8	10.2	10.8	9.1	6.8	4.5	4.5	5.1
August	51.1	10.3	9.6	13.2	8.2	4.8	2.1	0.7	0.0
September	43.7	13.9	11.3	9.0	8.4	6.1	3.9	2.5	1.3
JERSEYDALE:									
May	46.6	33.6	14.0	5.6	0.2	0.0	0.0	0.0	0.0
June	20.3	20.9	31.9	20.6	4.8	1.1	0.5	0.0	0.0
July	2.9	16.5	37.7	28.7	12.5	1.7	0.0	0.0	0.0
August	3.4	13.6	15.0	27.7	23.4	10.5	4.8	1.3	0.3
September	18.5	12.7	16.6	18.9	14.5	13.5	4.2	1.1	0.0
FIVE-MILE:									
May	43.9	29.0	16.9	9.7	0.4	0.1	0.0	0.0	0.0
June	22.6	17.0	23.0	24.8	8.8	3.5	0.3	0.0	0.0
July	5.0	9.5	26.3	32.0	20.1	4.6	2.5	0.0	0.0
August	14.2	20.6	33.7	20.0	10.3	1.1	0.0	0.0	0.0
September	6.1	12.2	17.9	26.8	17.3	12.2	7.2	0.2	0.0
SLY PARK:									
May	87.3	11.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0
June	67.1	28.2	4.7	0.0	0.0	0.0	0.0	0.0	0.0
July	47.6	16.4	14.9	13.0	4.9	1.6	0.9	0.6	0.0
August	60.4	24.5	9.0	3.9	1.4	0.7	0.0	0.0	0.0
September	43.2	16.2	18.9	12.2	6.3	2.4	0.7	0.1	0.0
WHITE CLOUD:									
May	58.1	29.1	9.8	2.5	0.6	0.0	0.0	0.0	0.0
June	20.1	27.5	19.8	17.0	10.3	3.6	1.3	0.4	0.0
July	8.0	23.1	23.2	22.8	13.7	7.1	1.9	0.3	0.0
August	19.8	14.5	23.9	23.1	14.5	3.0	0.9	0.3	0.0
September	11.7	15.6	26.8	26.0	11.5	5.0	2.2	0.6	0.6

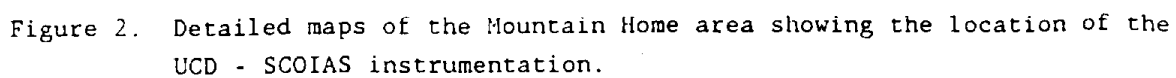
¹ Note: Data available for 7-24 to 7-31 only, a period of relatively high ozone concentrations.

TABLE 5

Summary of operational performance for 1991 observing season.

No.	Name	Dates of Operation	Percent of time data missed due to:						% time T>Tc
			I	II	III	IV	V	Total	
1	Mtn Home	5/25 - 10/15	21.1	0.2	0.4	0.0	0.3	22.1	--
2	Shaver Lk	7/24 - 10/15	0.0	0.0	2.7	0.0	0.4	3.1	18%
3	Jerseydale	5/09 - 10/15	0.0	0.3	13.6	0.0	0.6	14.5	59%
4	5-Mile L.C.	(3/02 - 10/15)	7.7	0.1	7.0	0.0	0.4	15.2	17%
5	Sly Park	(4/12 - 10/15)	0.0	0.0	19.6	0.1	0.3	20.0	16%
6	White Cld.	4/23 - 10/15	0.0	0.1	0.6	0.0	0.3	1.3	--

I = Computer system failures. IV = Meteorological instrument failures.
 II = AC power failures. V = Operational maintenance.
 III = Ozone monitor problems. Tc = 30 °C (Upper limit of EPA limits).



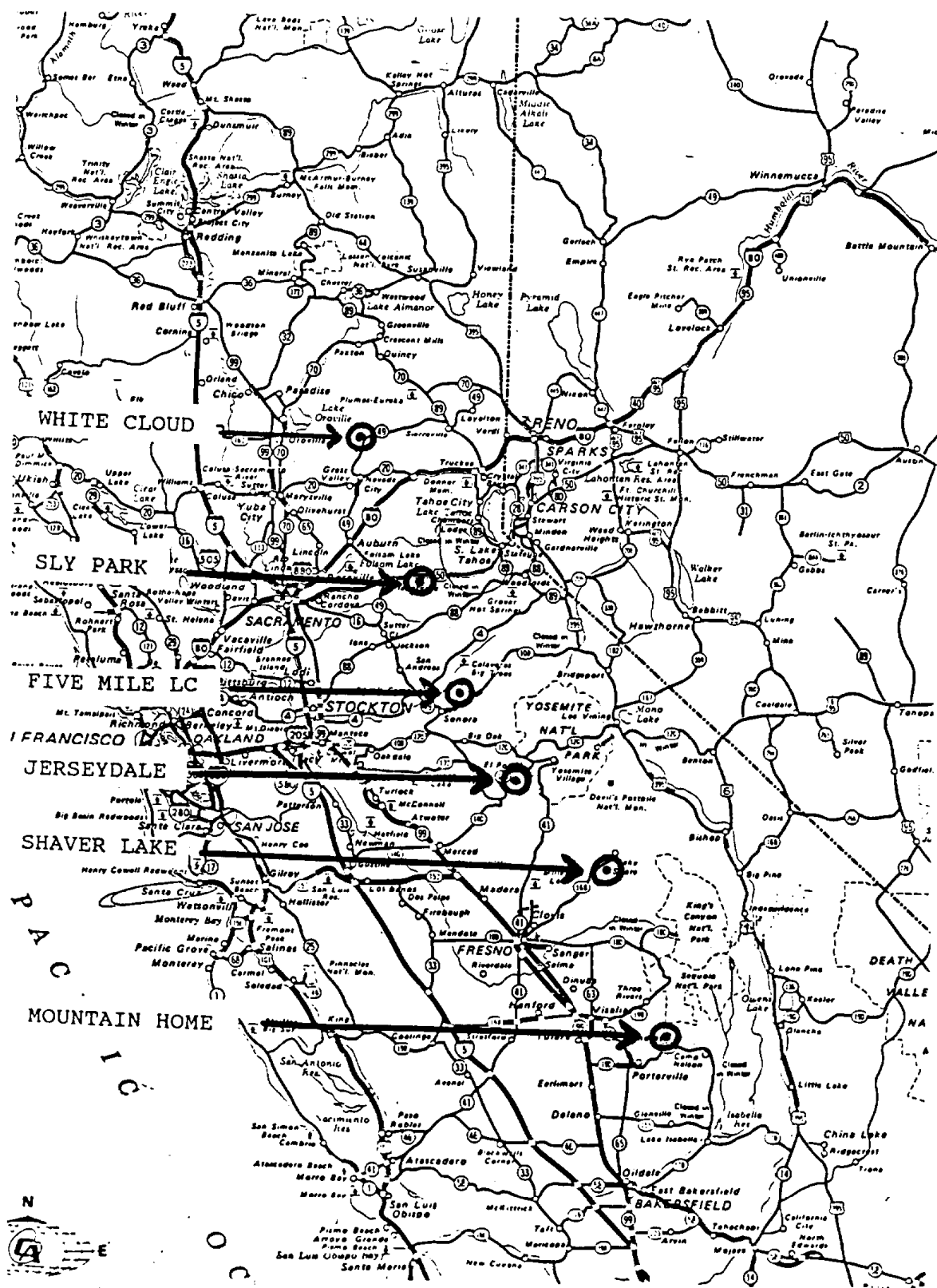


Figure 1. Map of central California showing the approximate locations of the ozone monitoring sites.

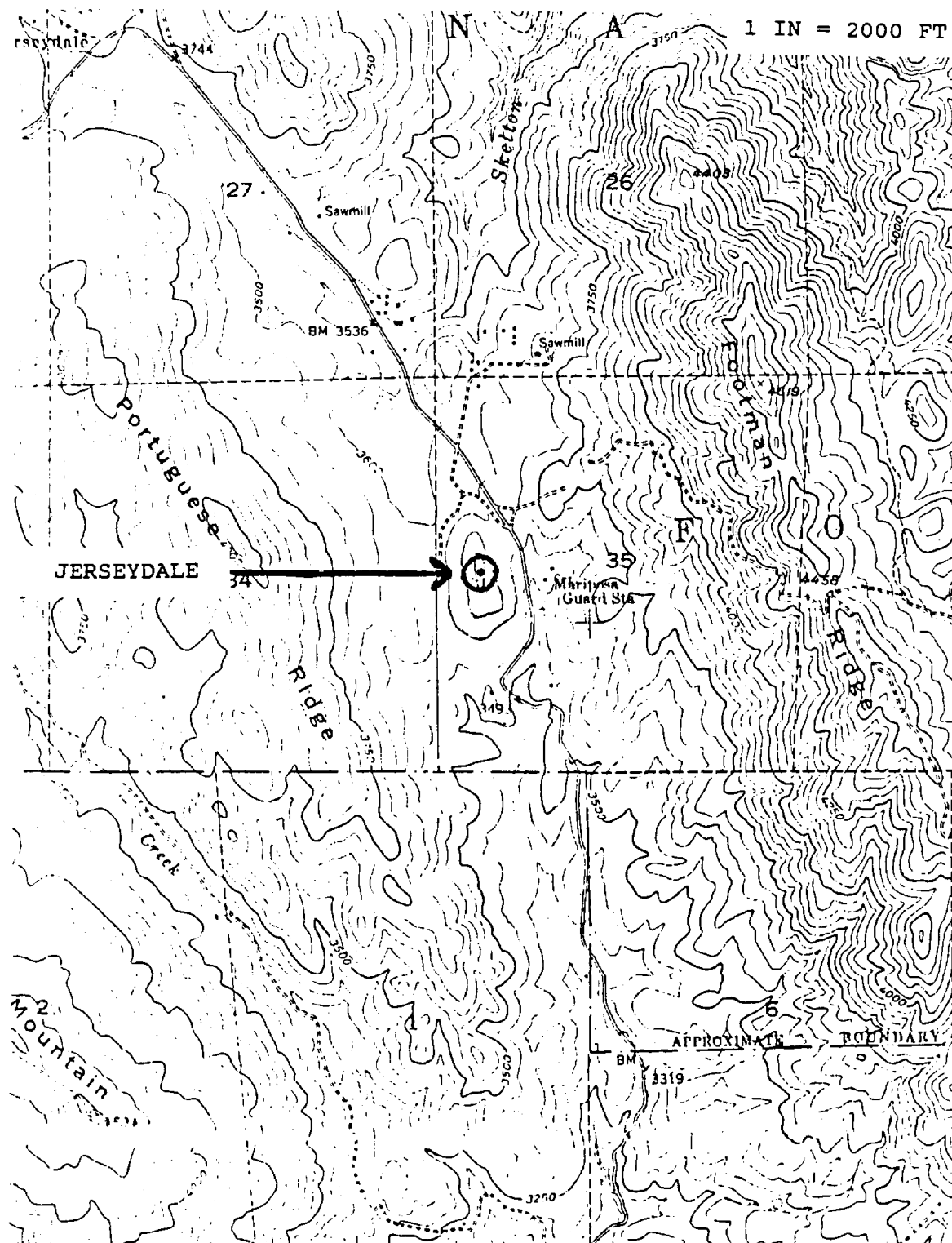


Figure 4. Detailed maps of the Jerseydale area showing the location of the UCD - SCOIAS instrumentation.

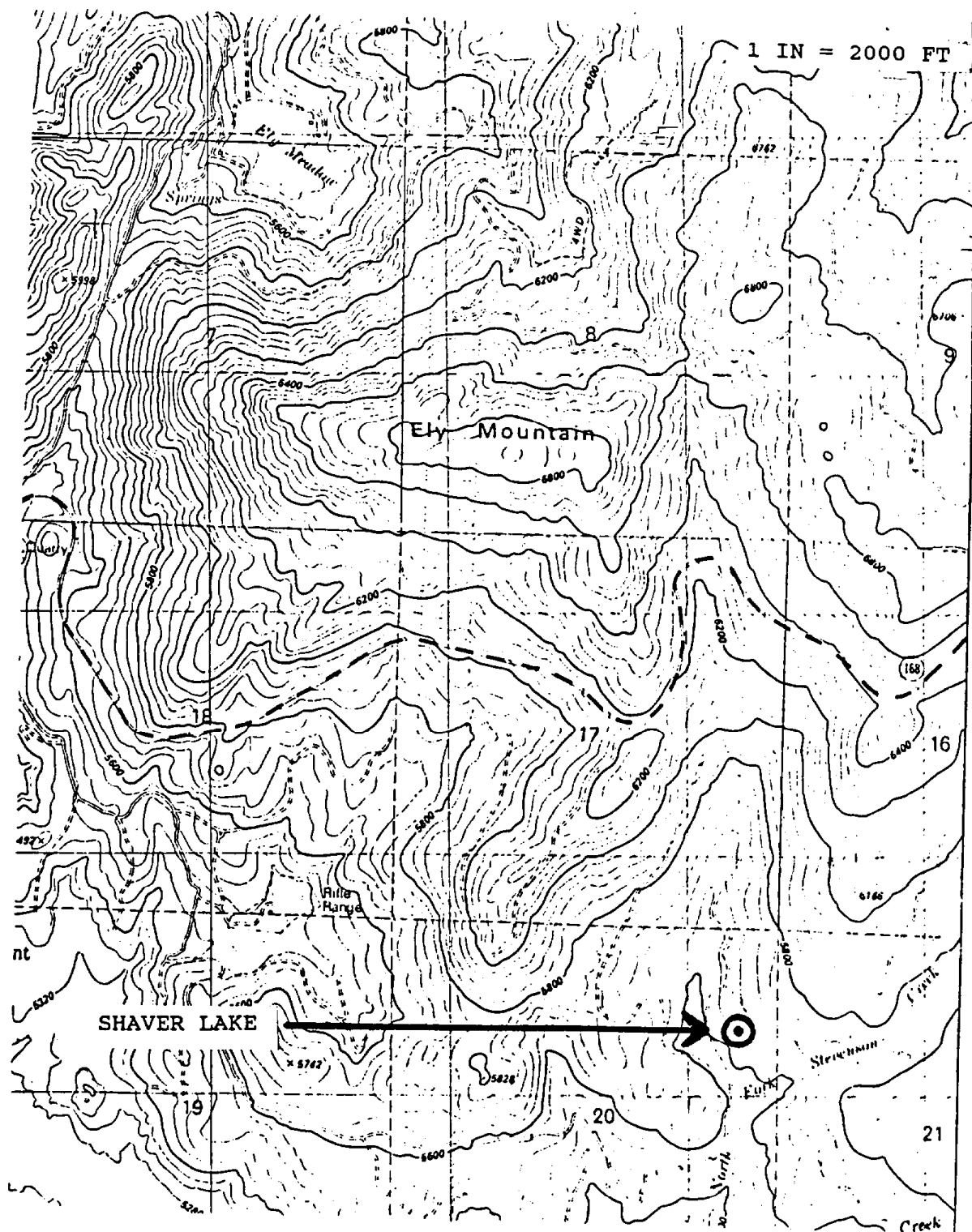


Figure 3. Detailed maps of the Shaver Lake area showing the location of the UCD - SCOIAS instrumentation.

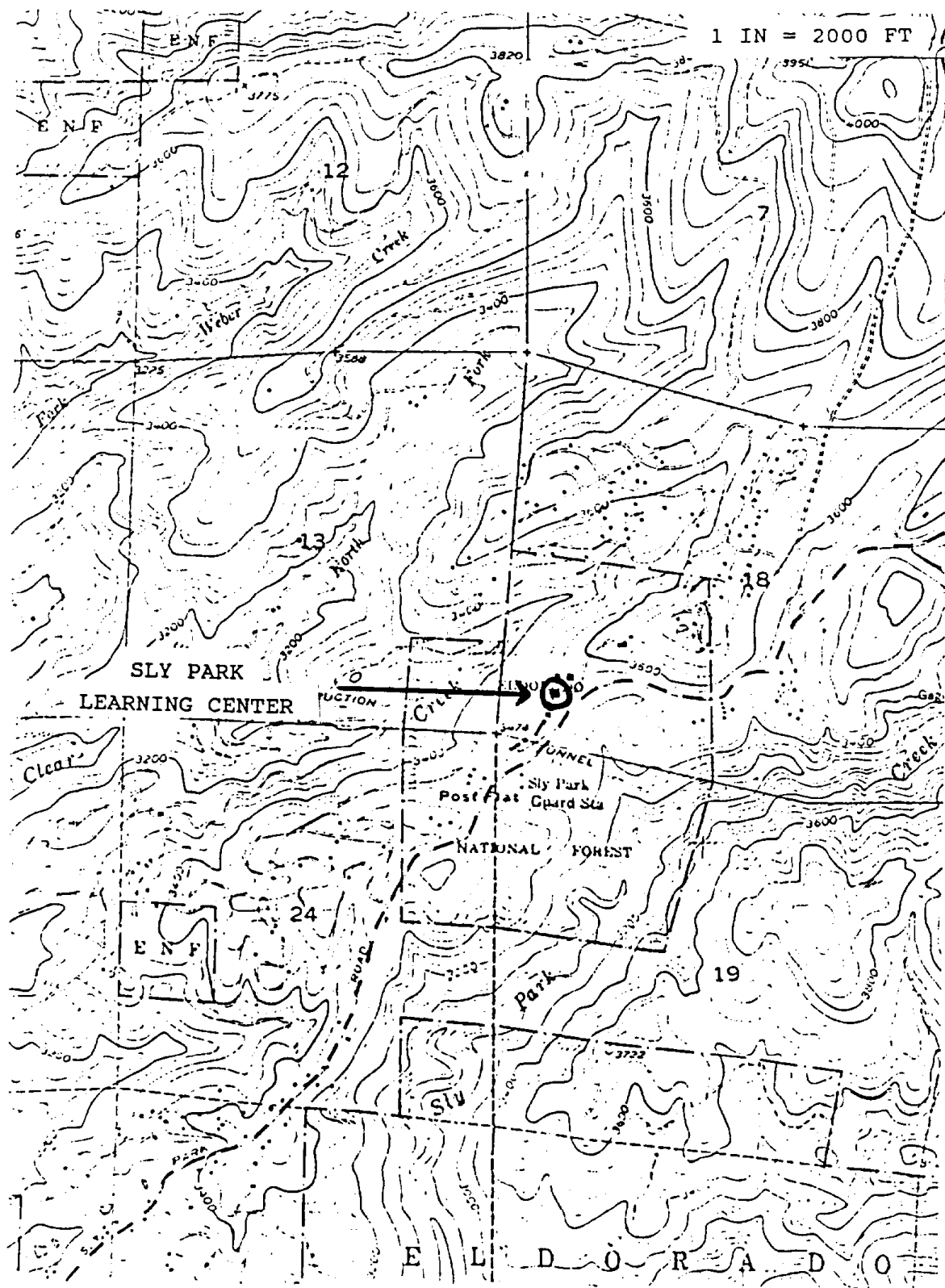


Figure 6. Detailed map of the Sly Park Learning Center area showing the location of the UCD - SCOIAS instrumentation.

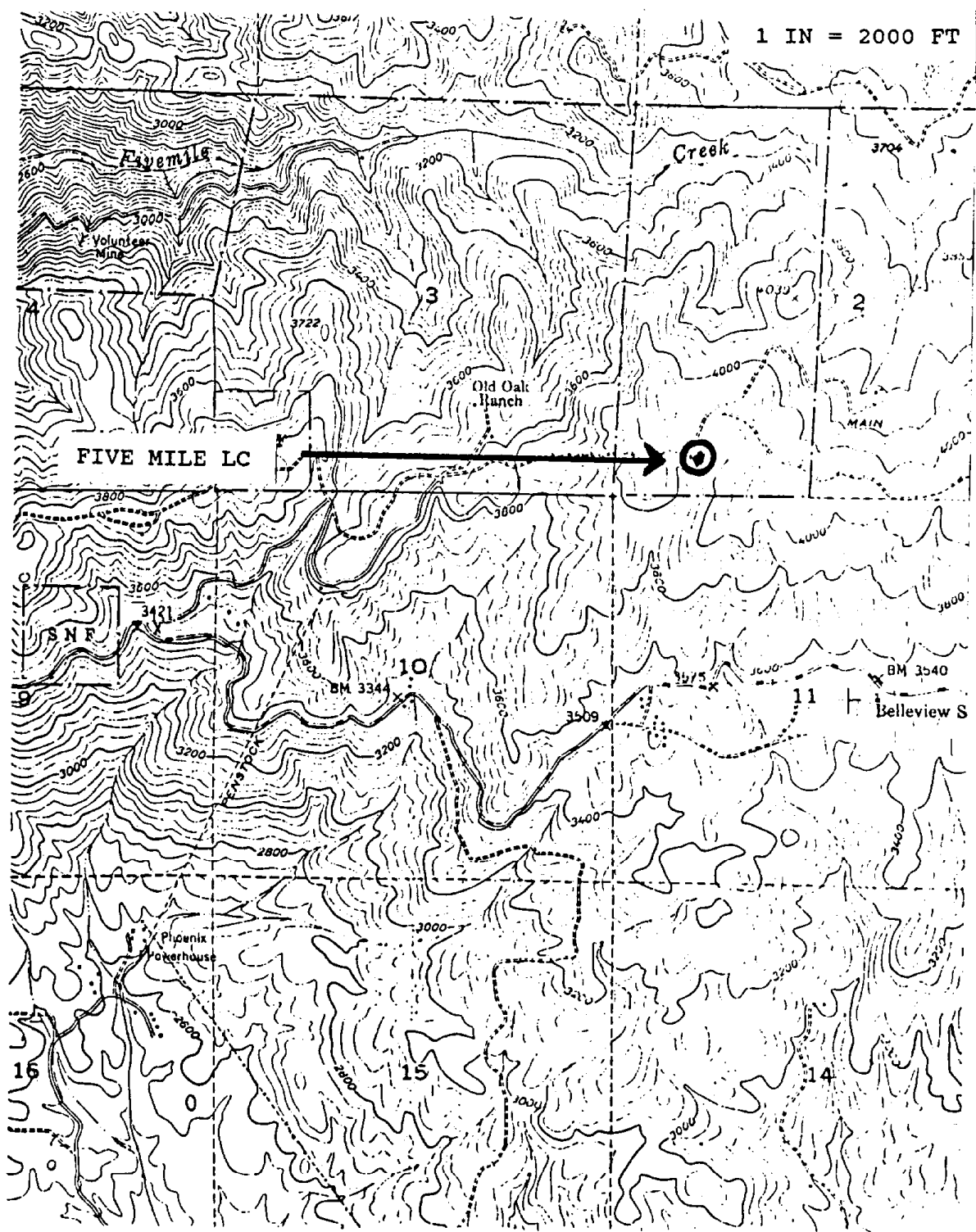


Figure 5. Detailed maps of the 5-mile Learning Center area showing the location of the UCD - SCOIAS instrumentation.

SCOIAS DATA PROCESSING

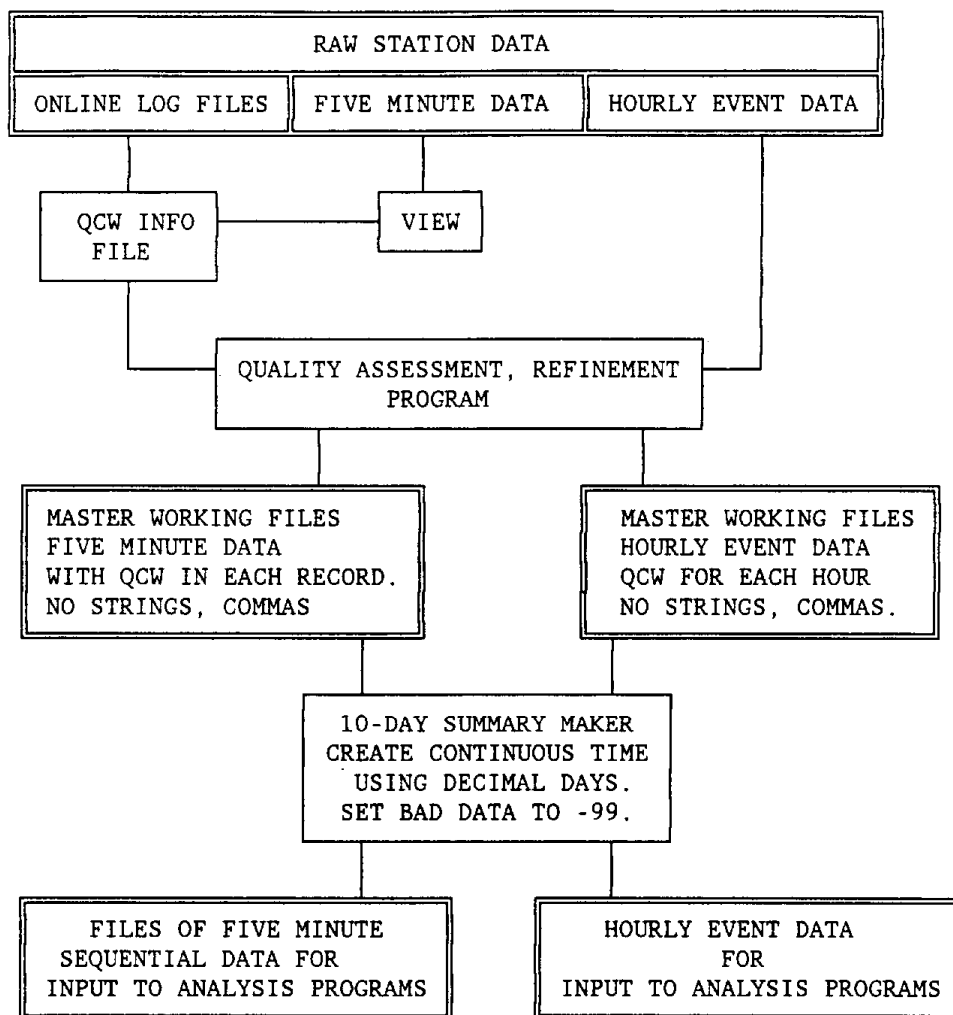


Figure 8. Summary of the SCOIAS data processing procedures. Boxes with double outline indicate data files. Boxes with single outlines represent data processing programs.

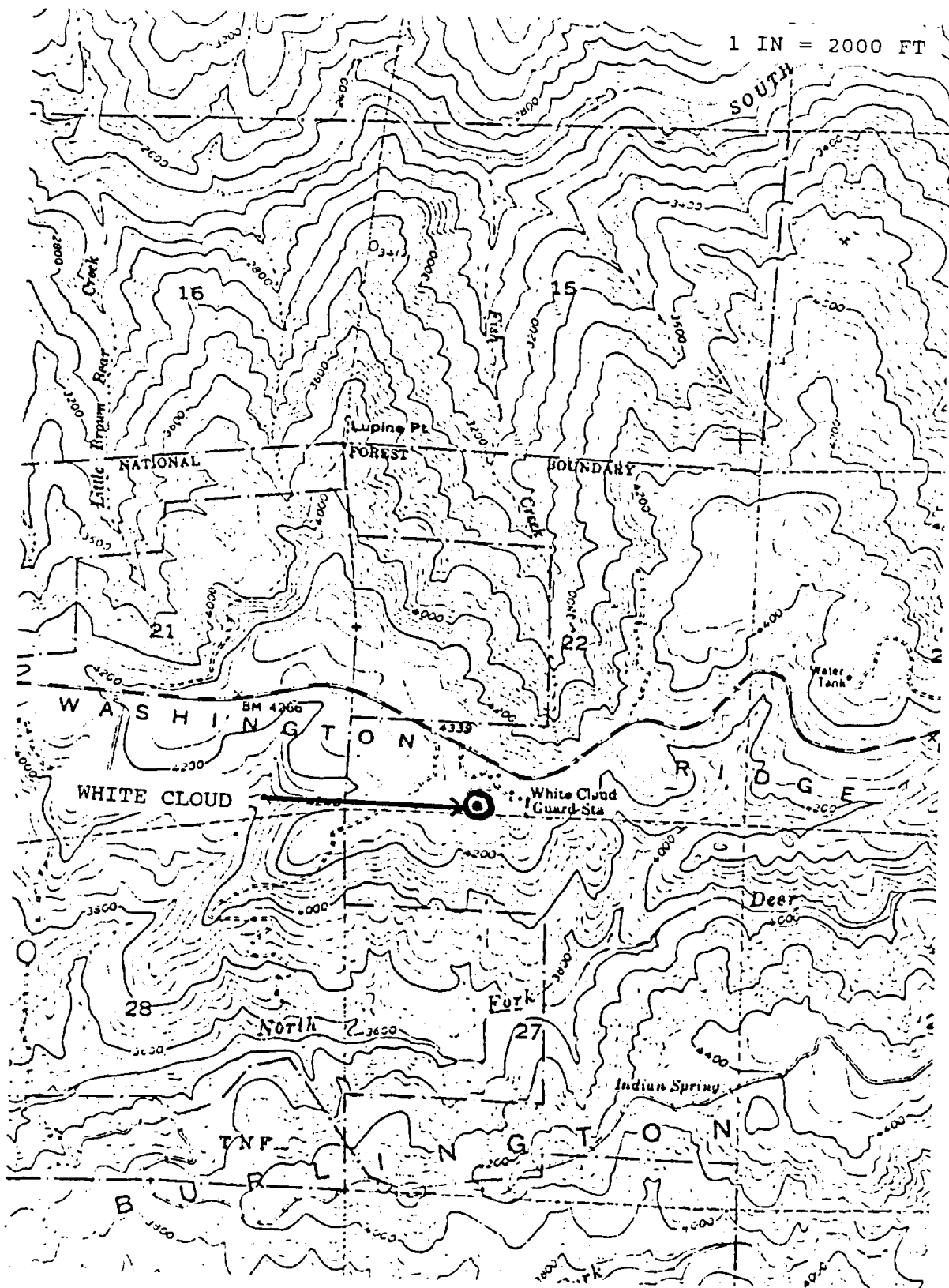


Figure 7. Detailed map of the White Cloud area showing the location of the UCD - SCOIAS instrumentation.

MOUNTAIN HOME 7/91

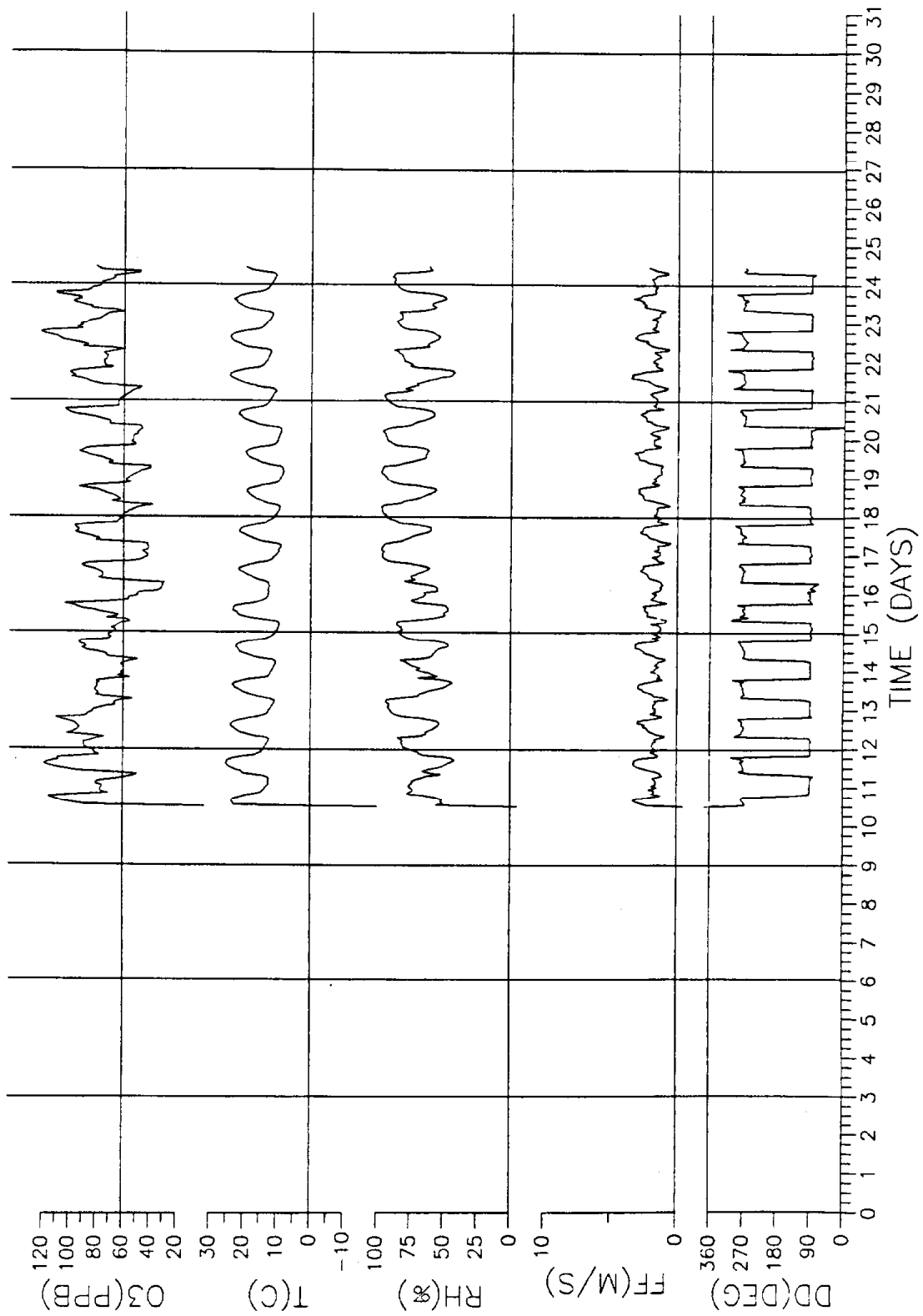


Figure 9(b)

MOUNTAIN HOME 6/91

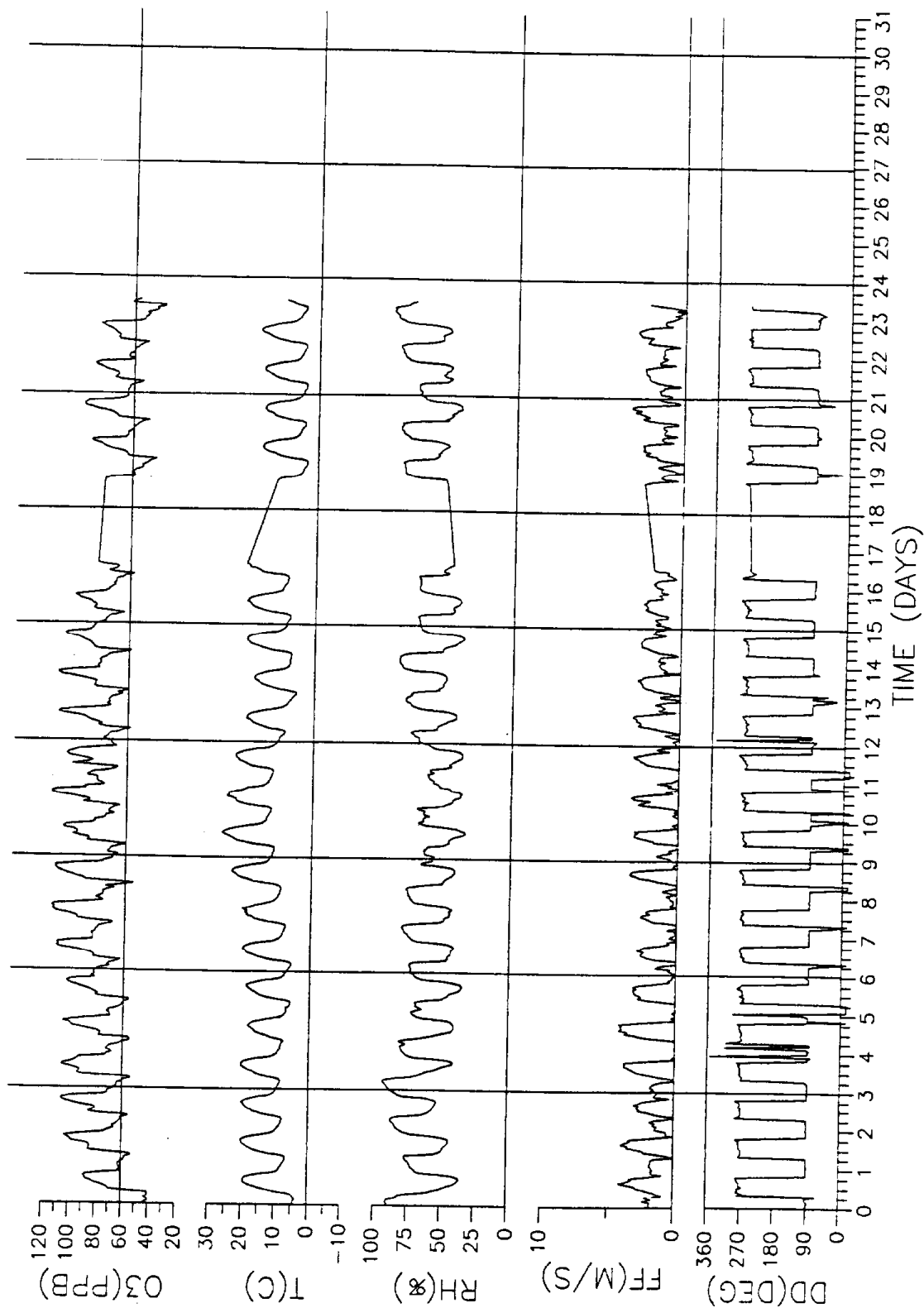


Figure 9. Time plots of hourly averaged wind direction (DD), wind speed (FF), relative humidity (RH), air temperature (T) and volumetric ozone concentration (O3) normalized to standard conditions of temperature and pressure at the Mountain Home site for the months June (a) through November (f). Wind direction values greater than 360 indicate calm conditions. Values of any variable less than 0 indicate missing or bad data.

MOUNTAIN HOME 9/91

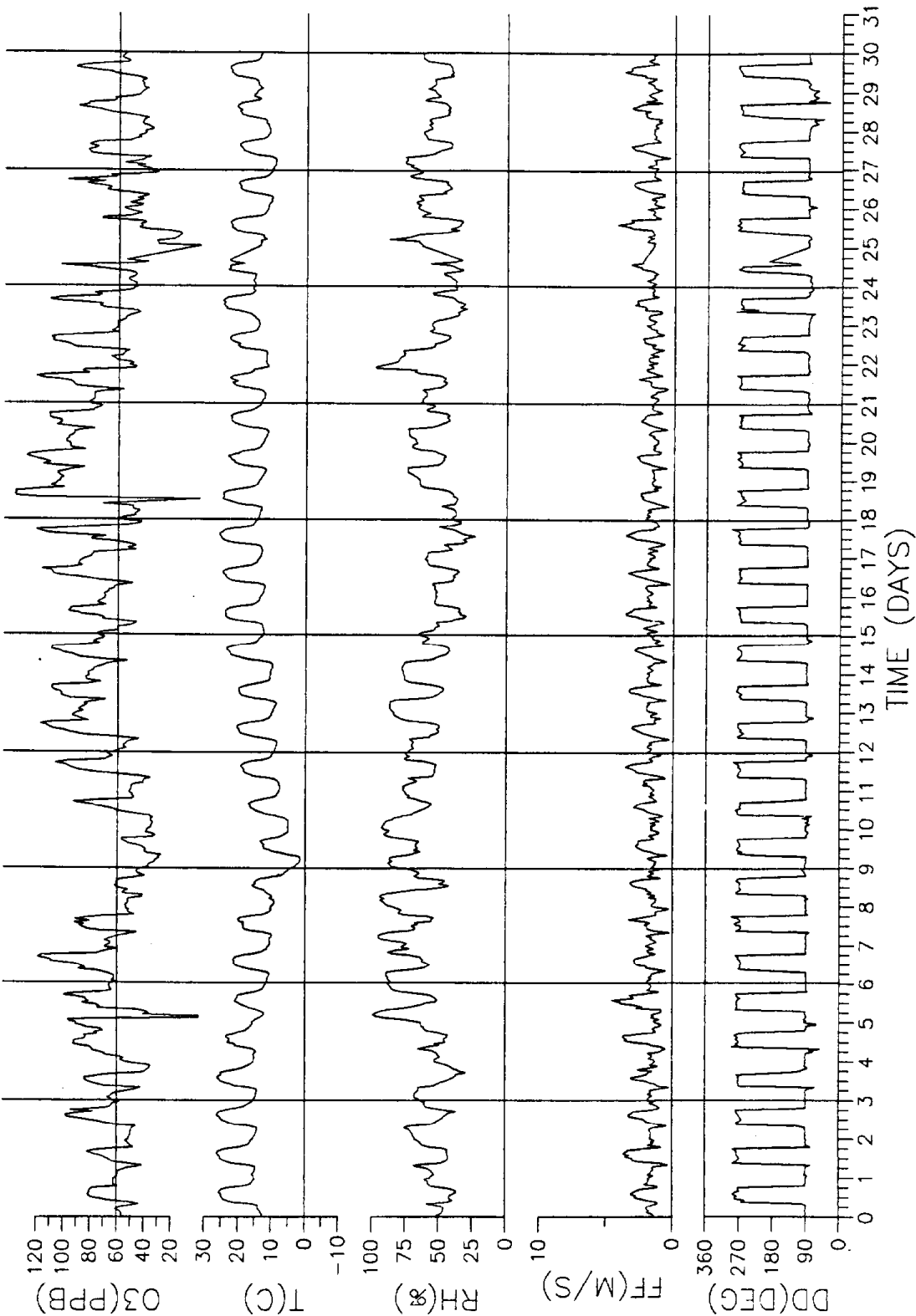


Figure 9(d)

MOUNTAIN HOME 8/91

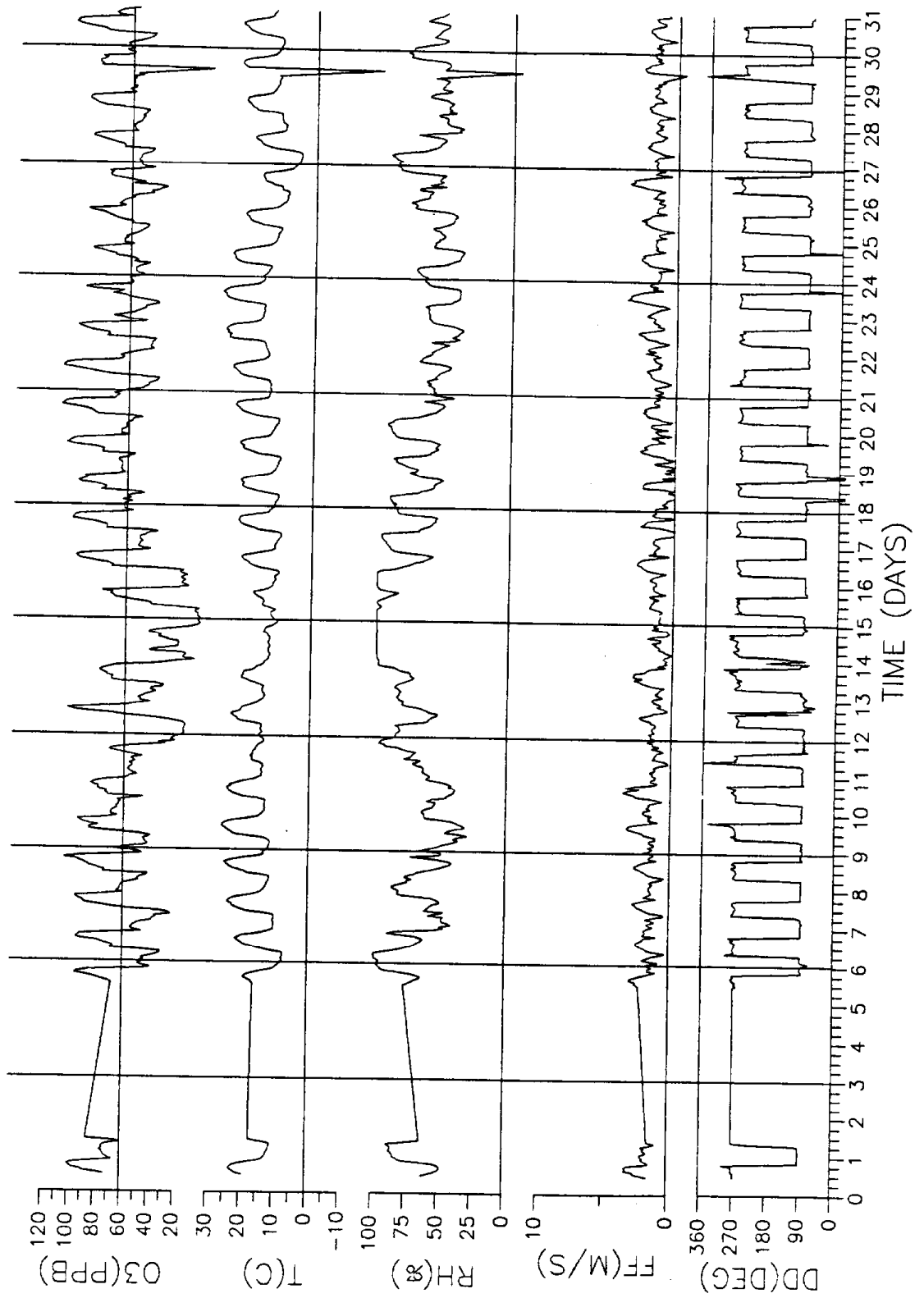


Figure 9(c)

MOUNTAIN HOME 11/91

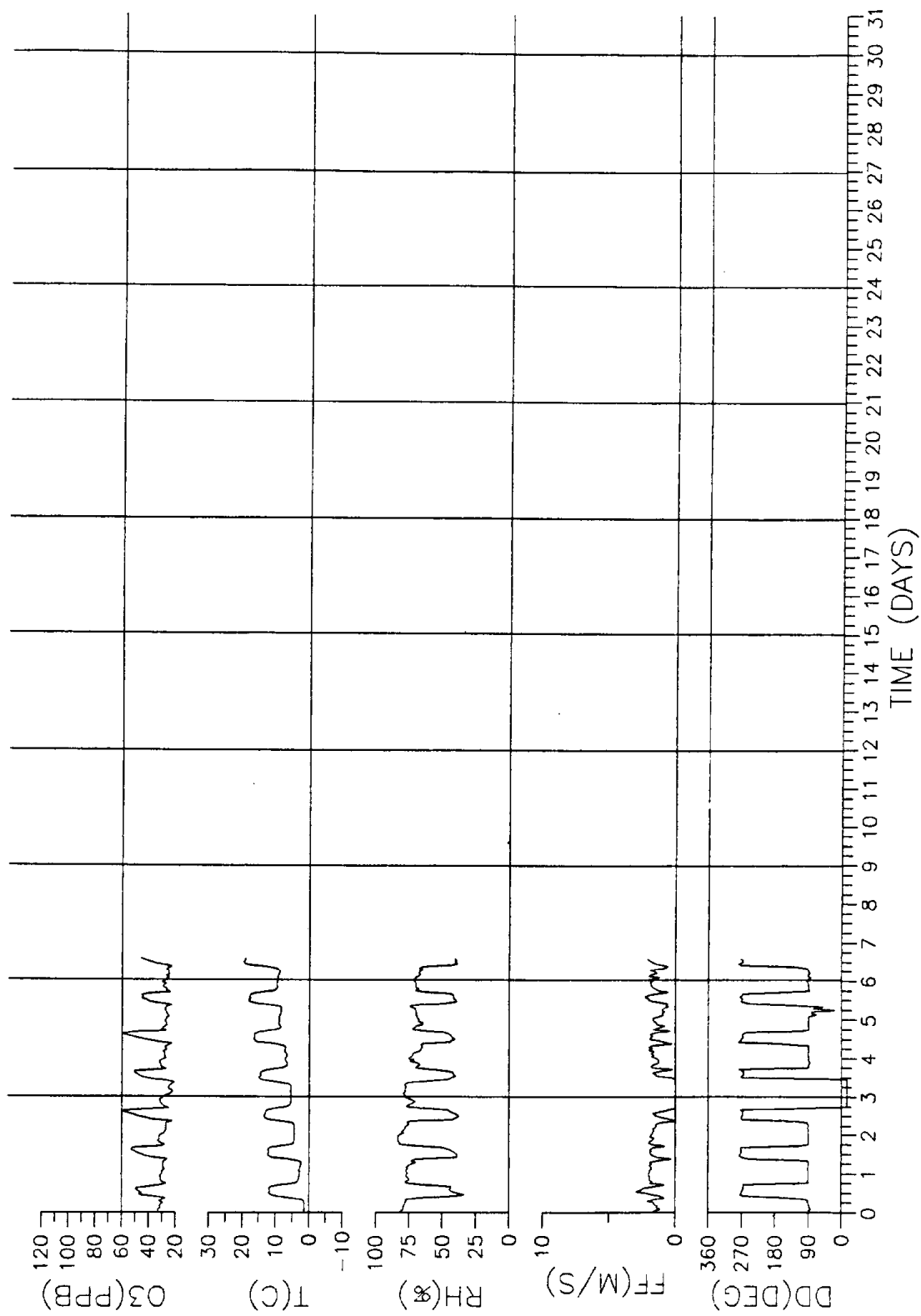


Figure 9(f)

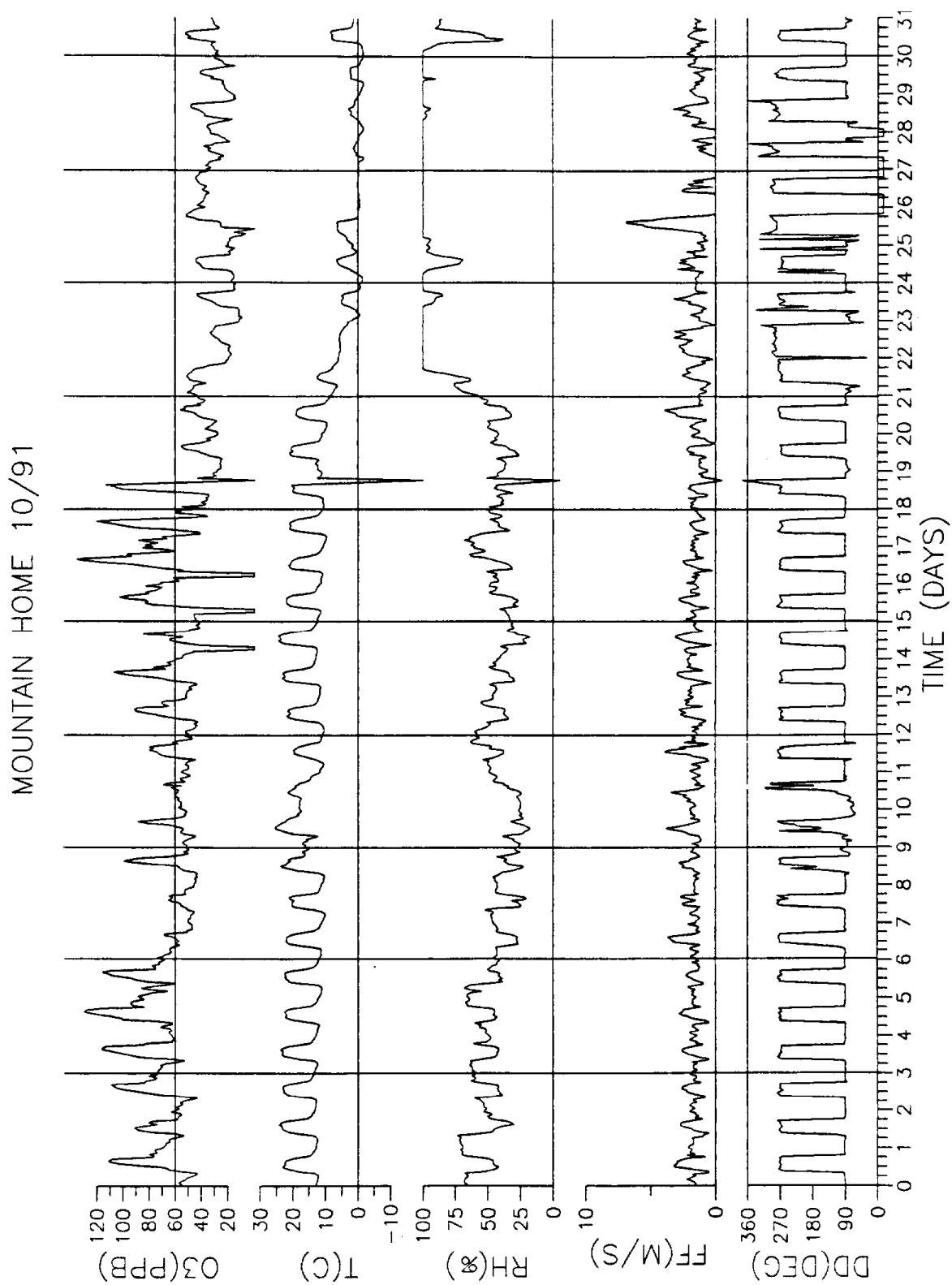


Figure 9(e)

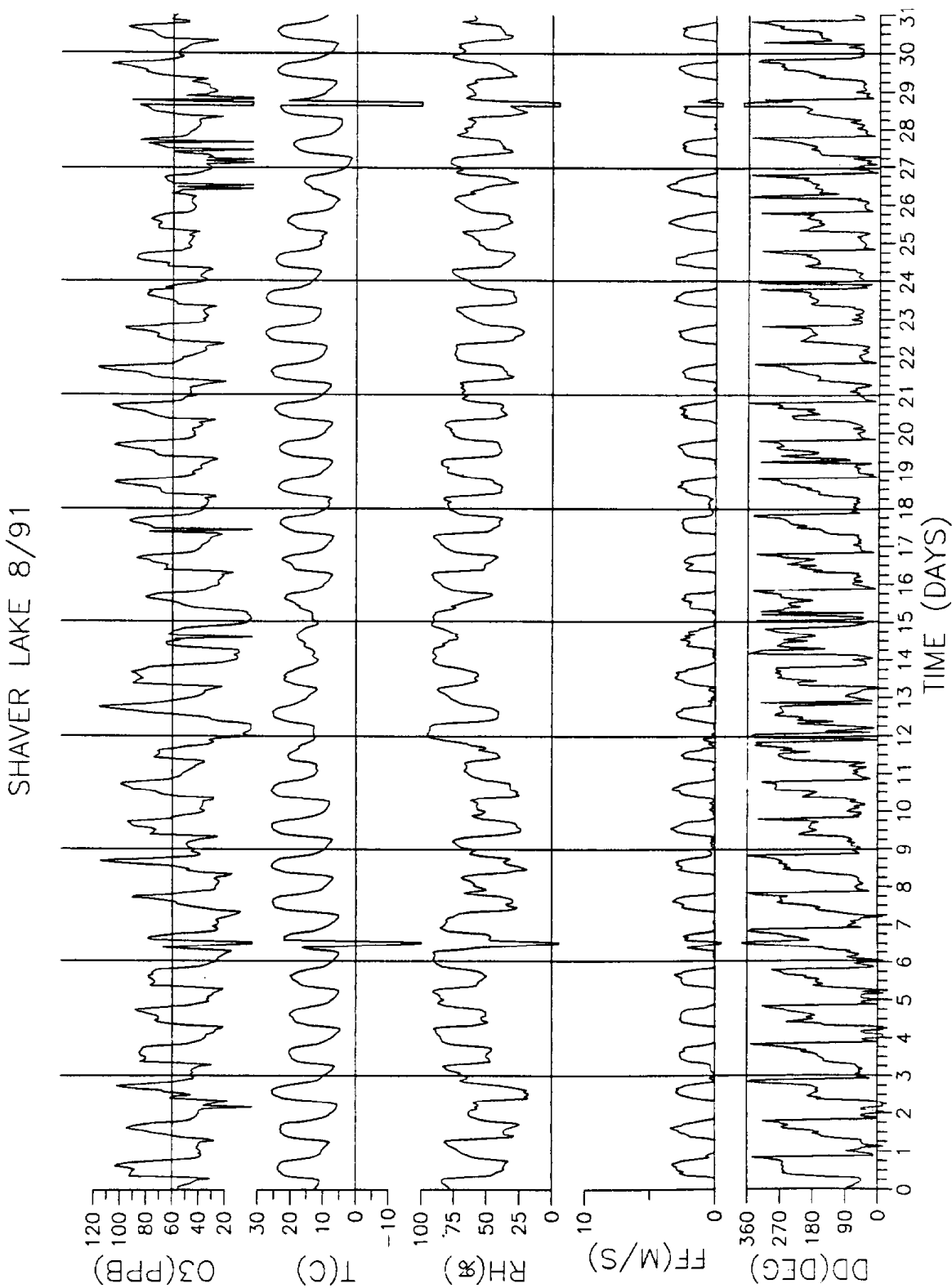


Figure 10(b)

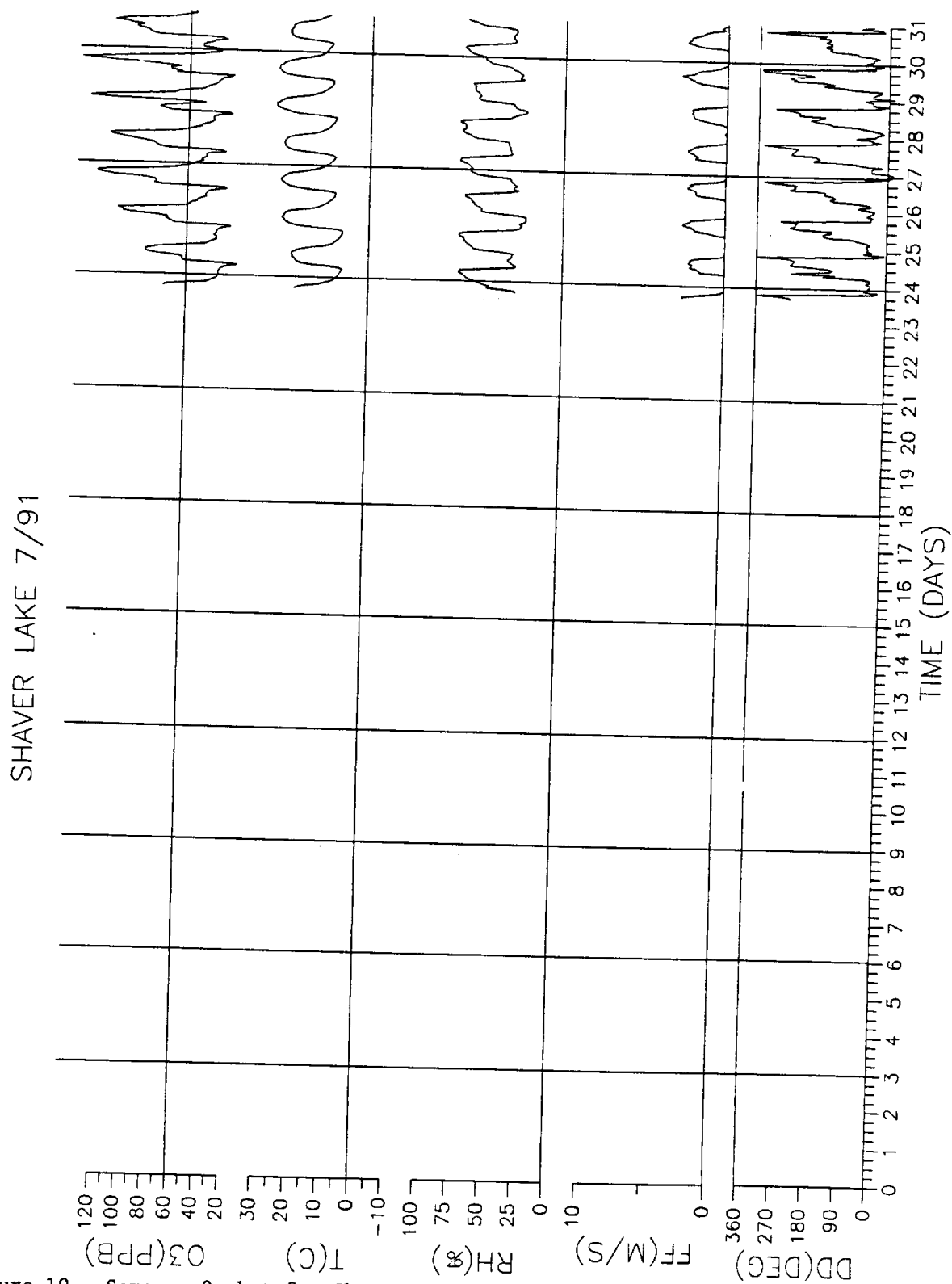


Figure 10. Same as 9, but for Shaver Lake and the months July (a) through November (e).

SHAVER LAKE 10/91

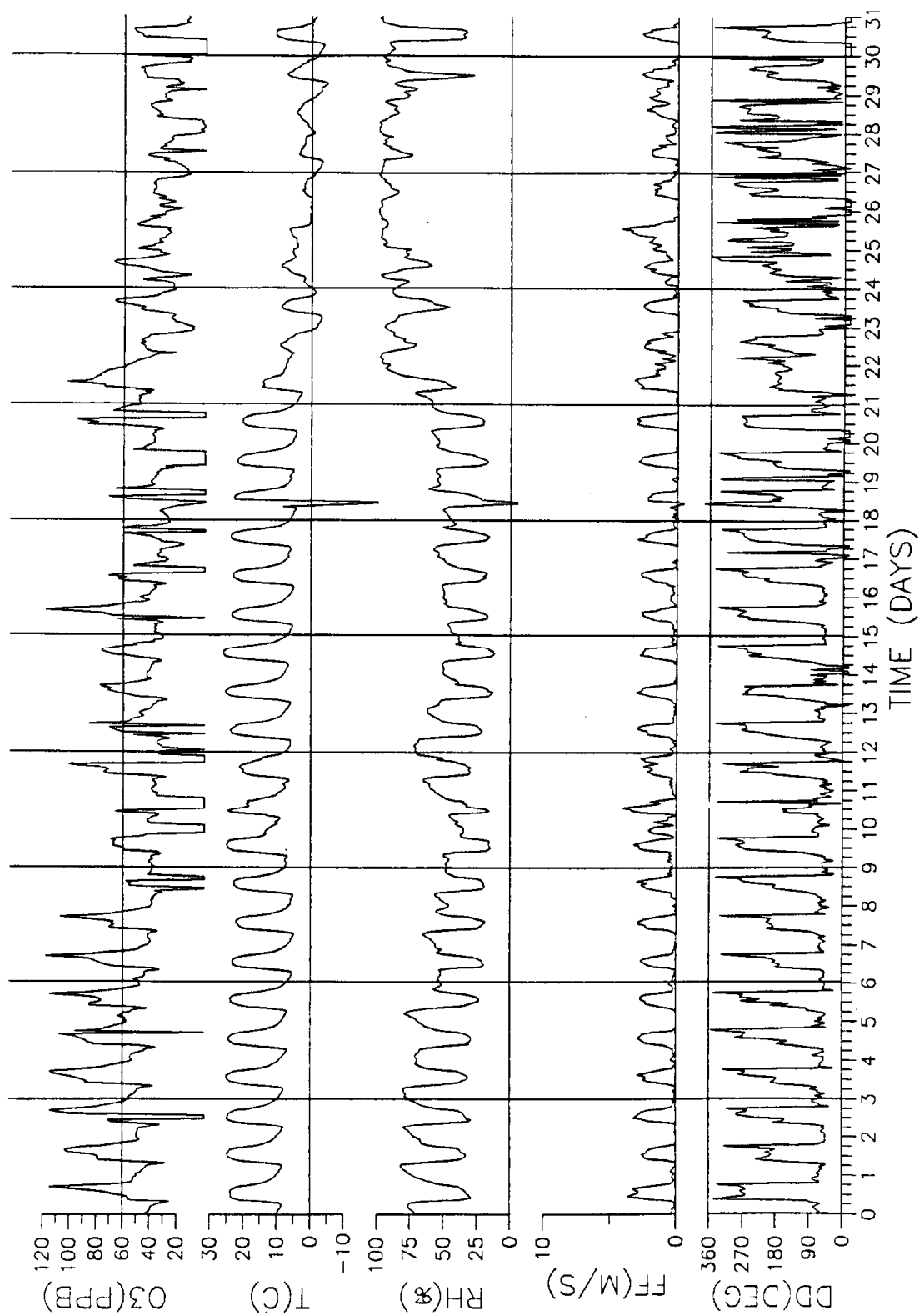


Figure 10(d)

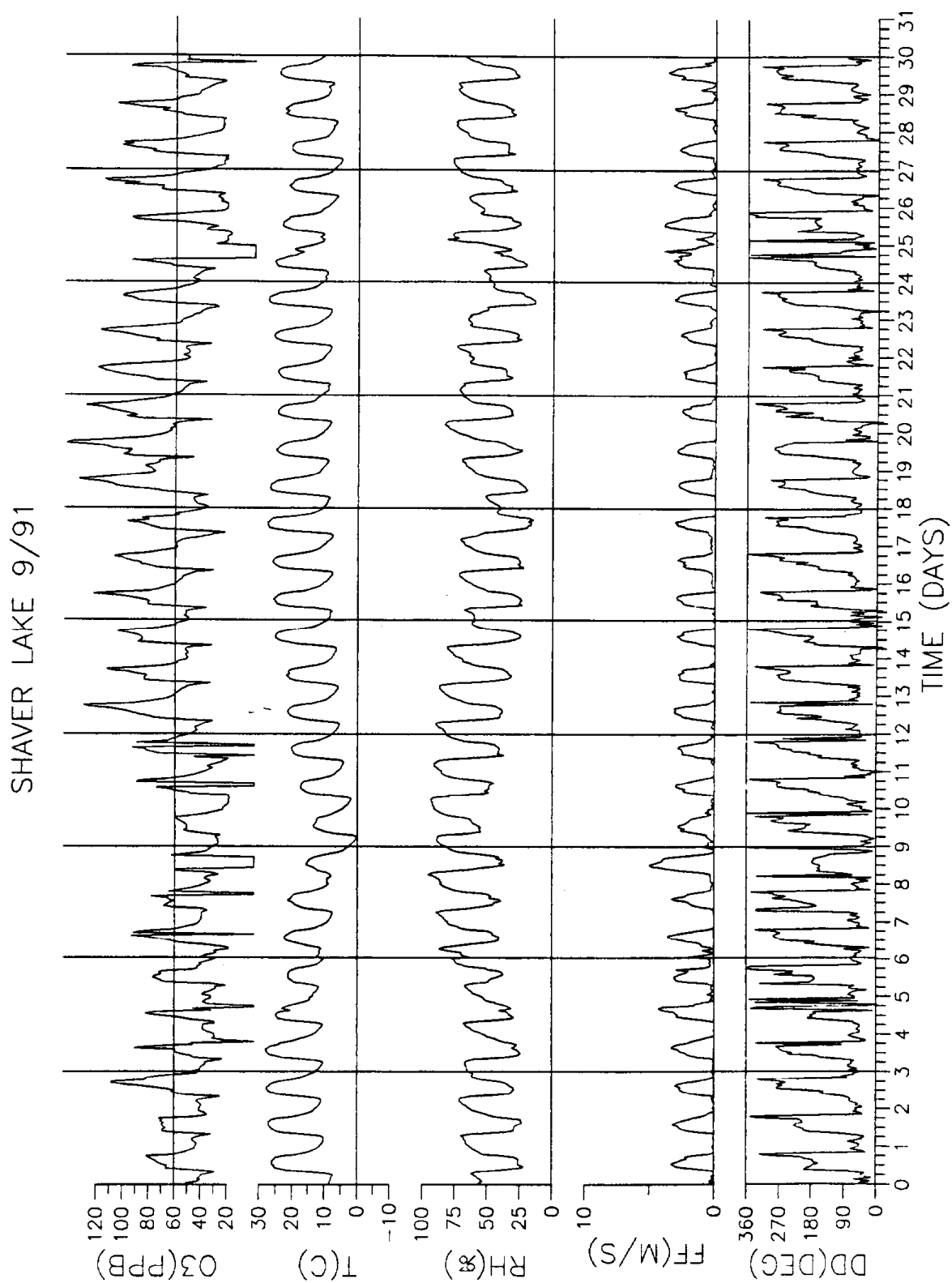


Figure 10(c)

JERSEYDALE 5/91

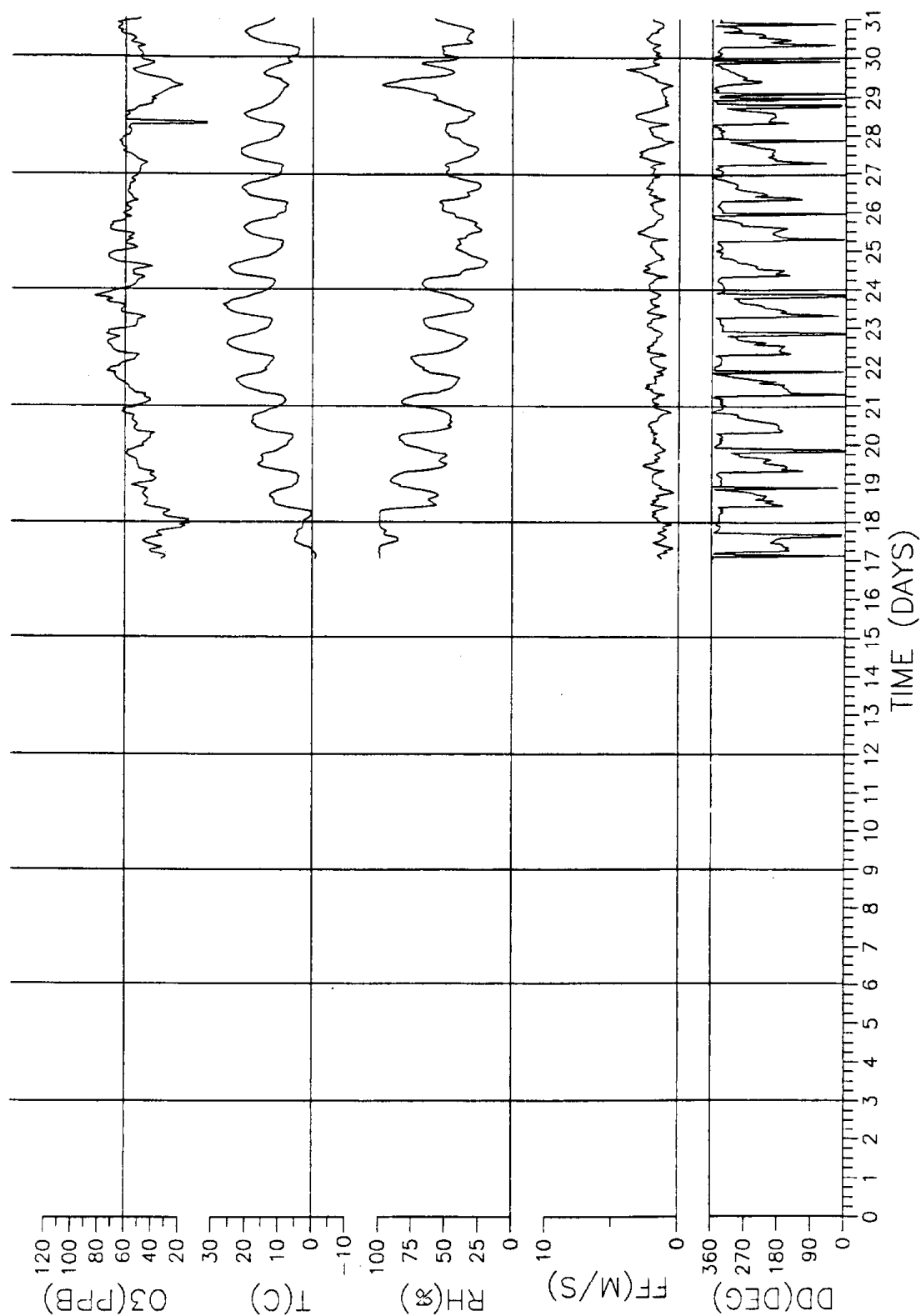


Figure 11. Same as 9, but for Jerseydale and the months of May (a) through November (e).

SHAVER LAKE 11/91

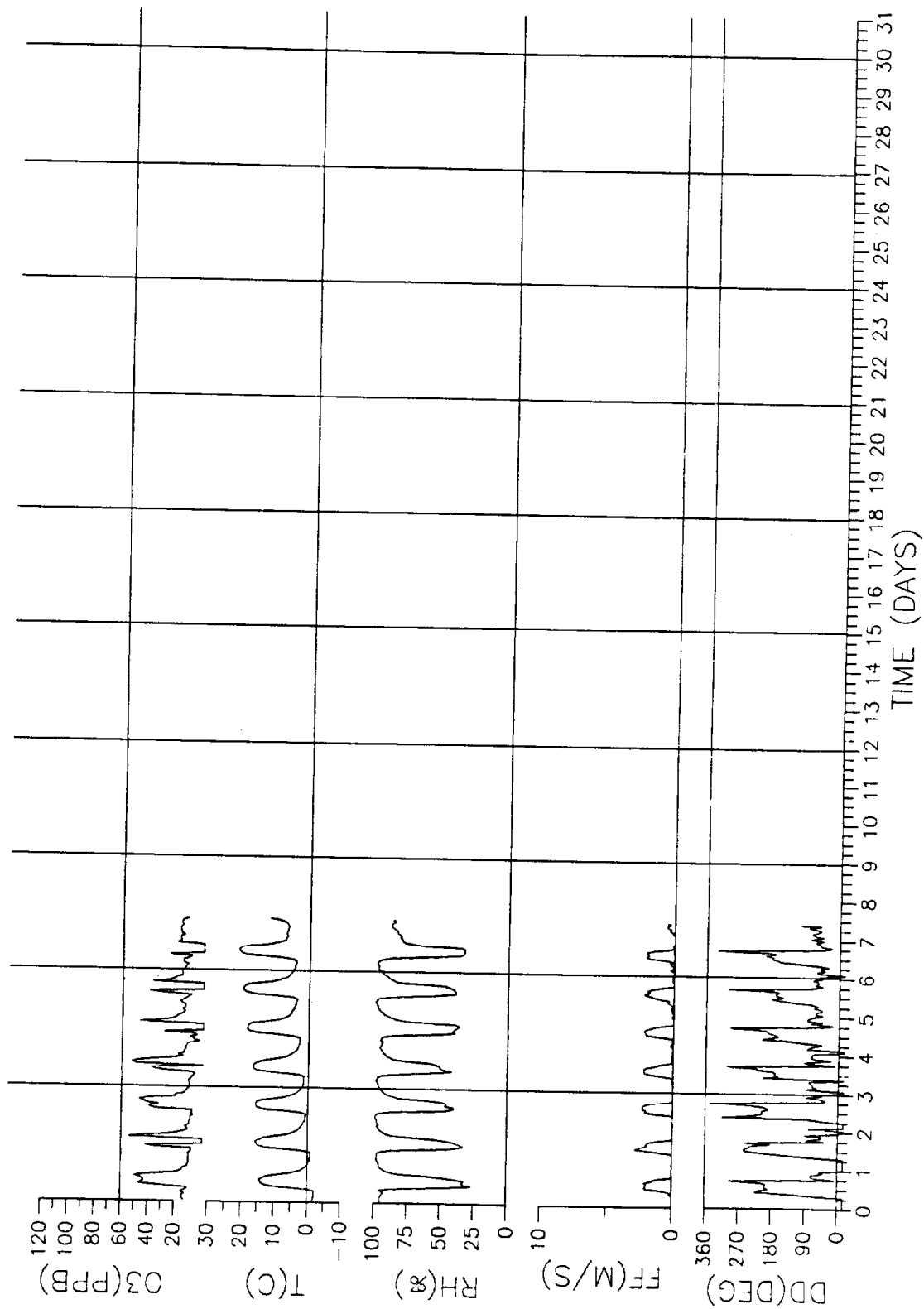


Figure 10(e)

JERSEYDALE 7/91

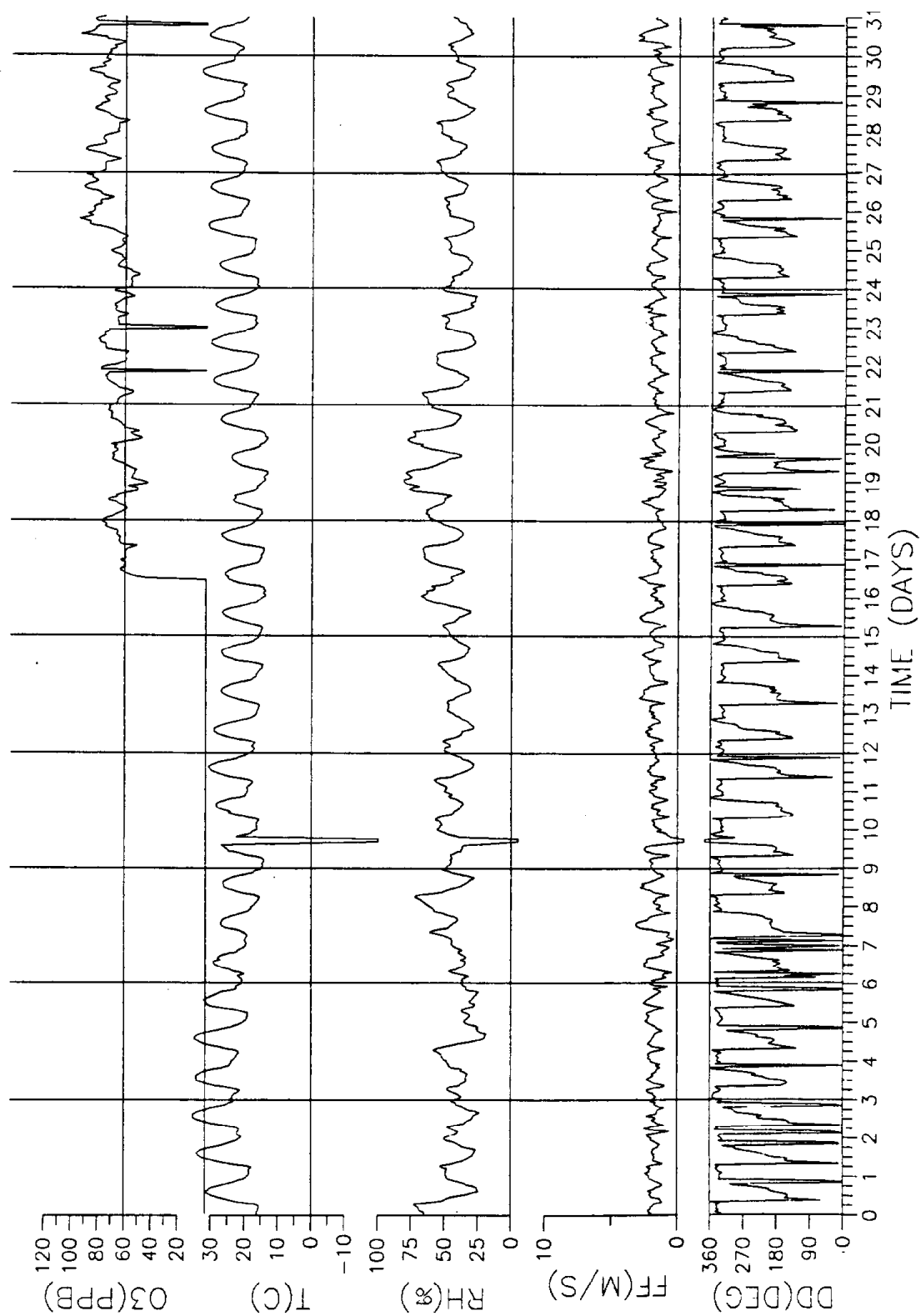


Figure 11(c)

JERSEYDALE 6/91

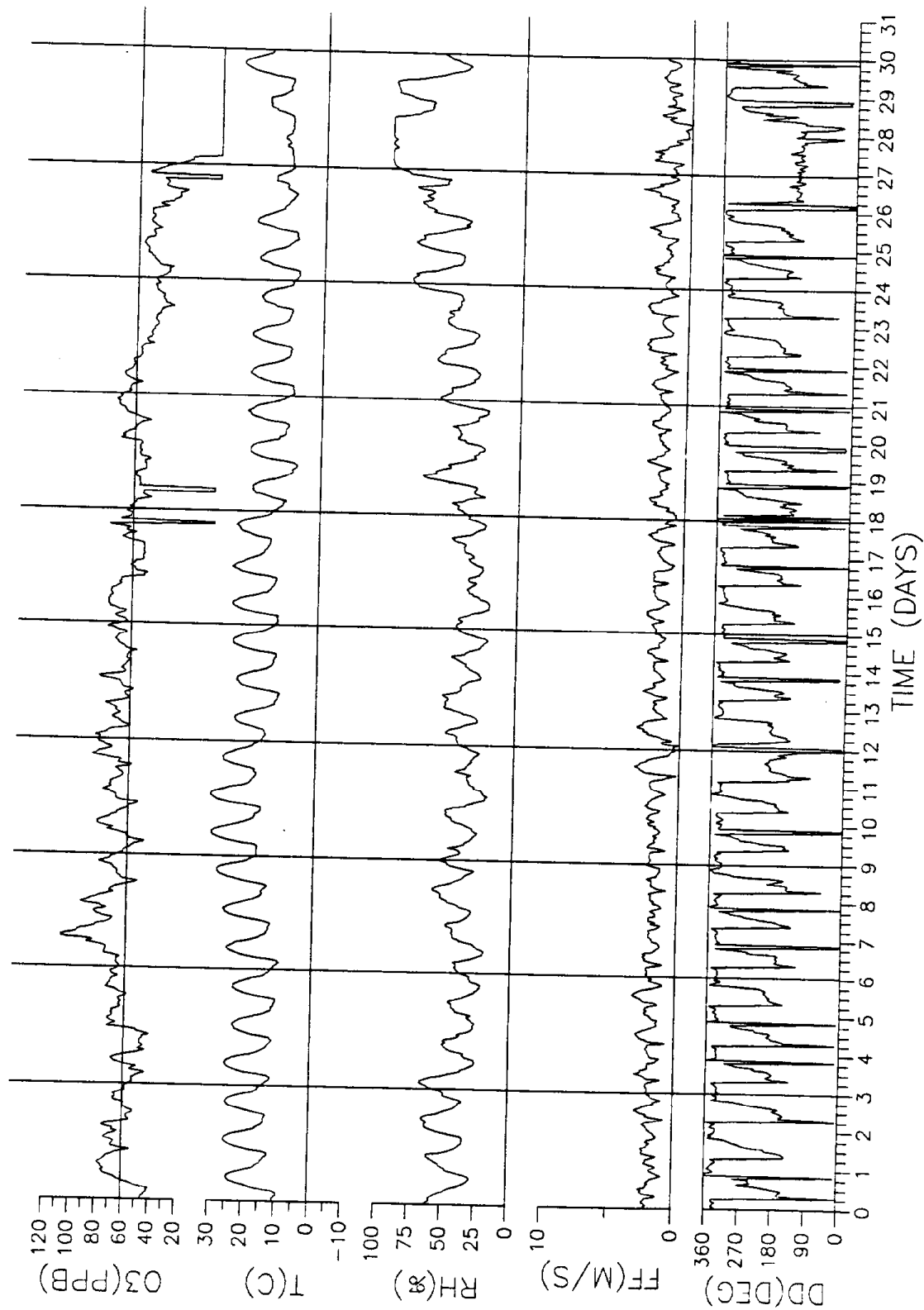


Figure 11(b)

JERSEYDALE 9/91

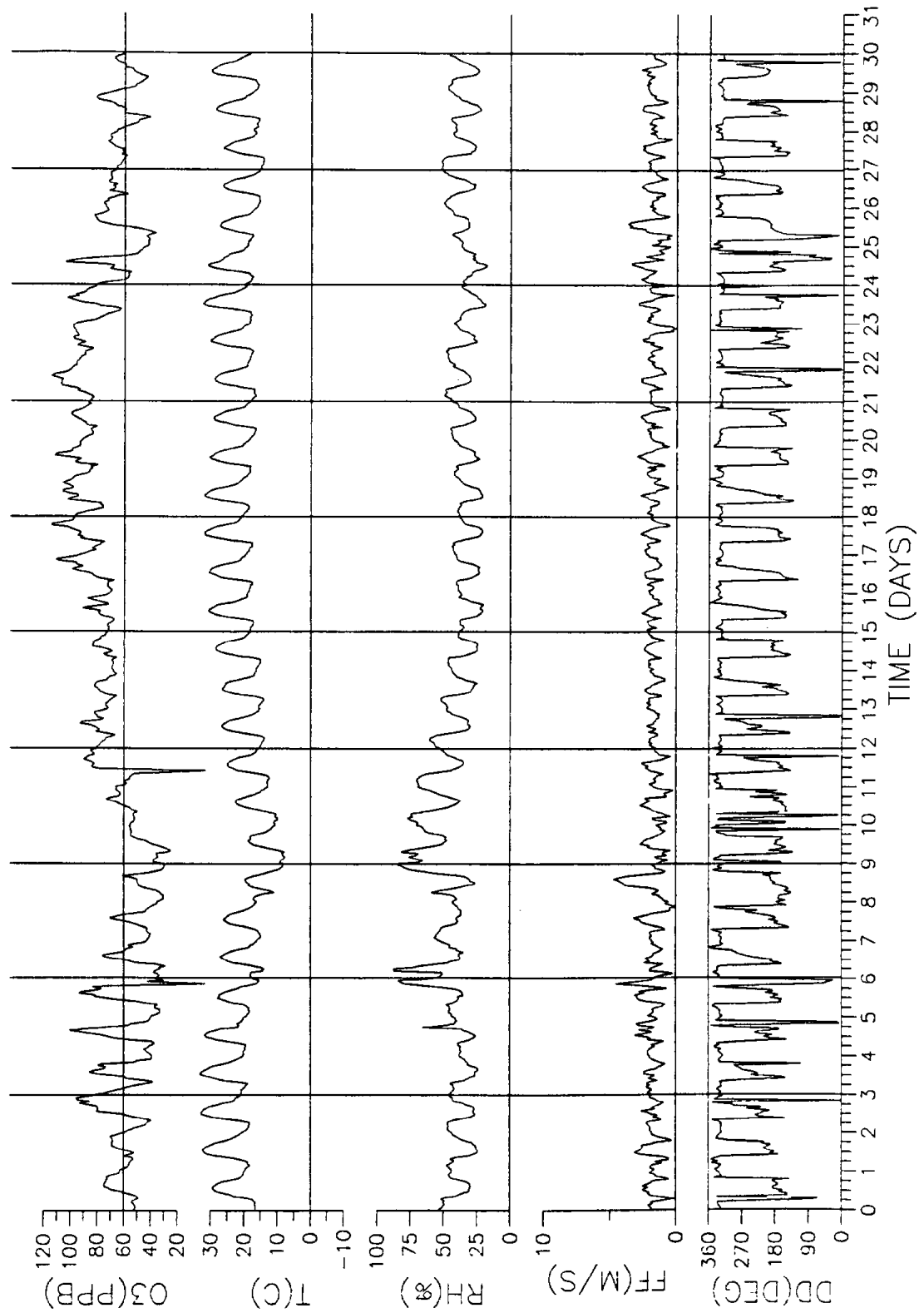


Figure 11(e)

JERSEYDALE 8/91

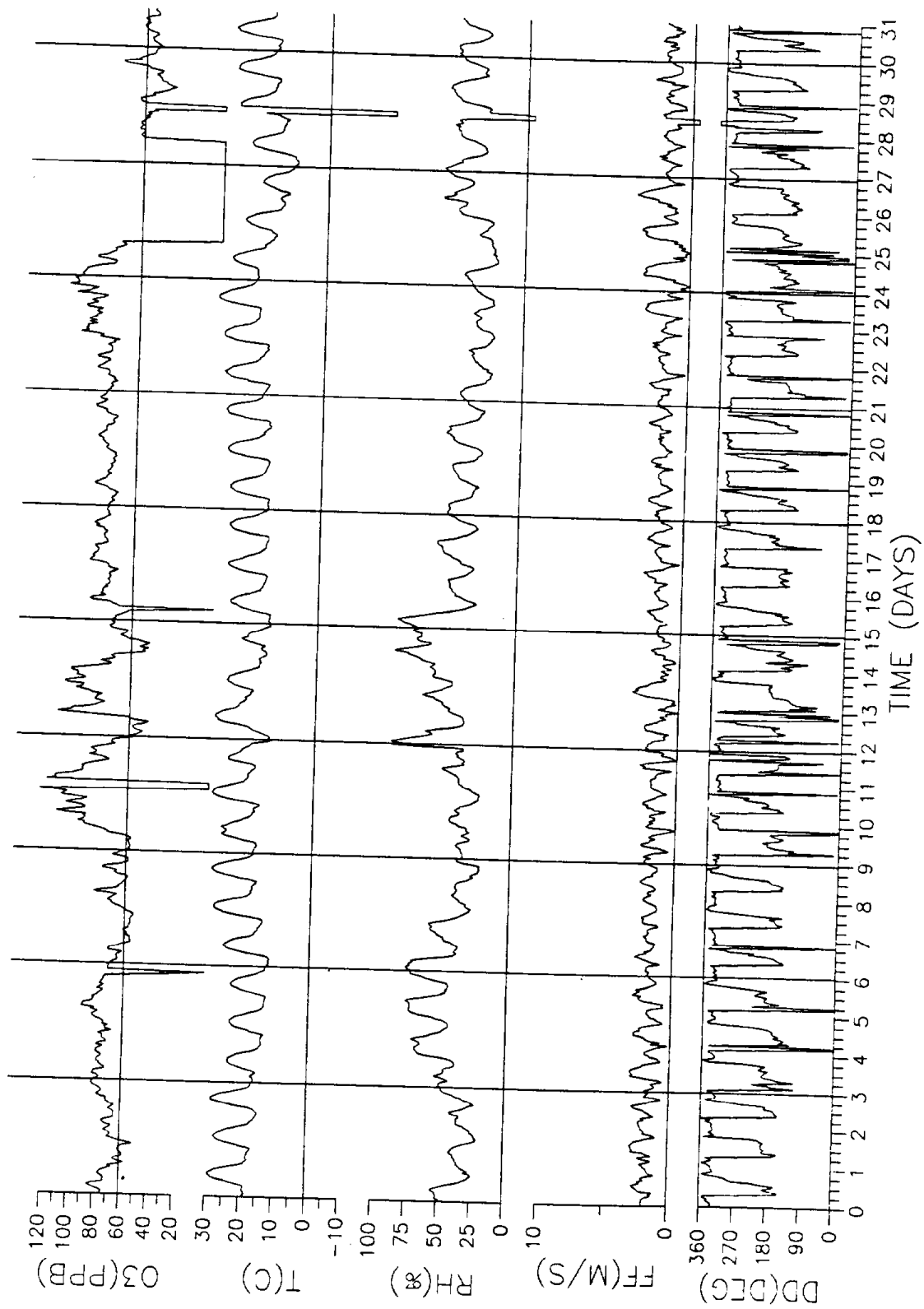


Figure 11(d)

JERSEYDALE 11/91

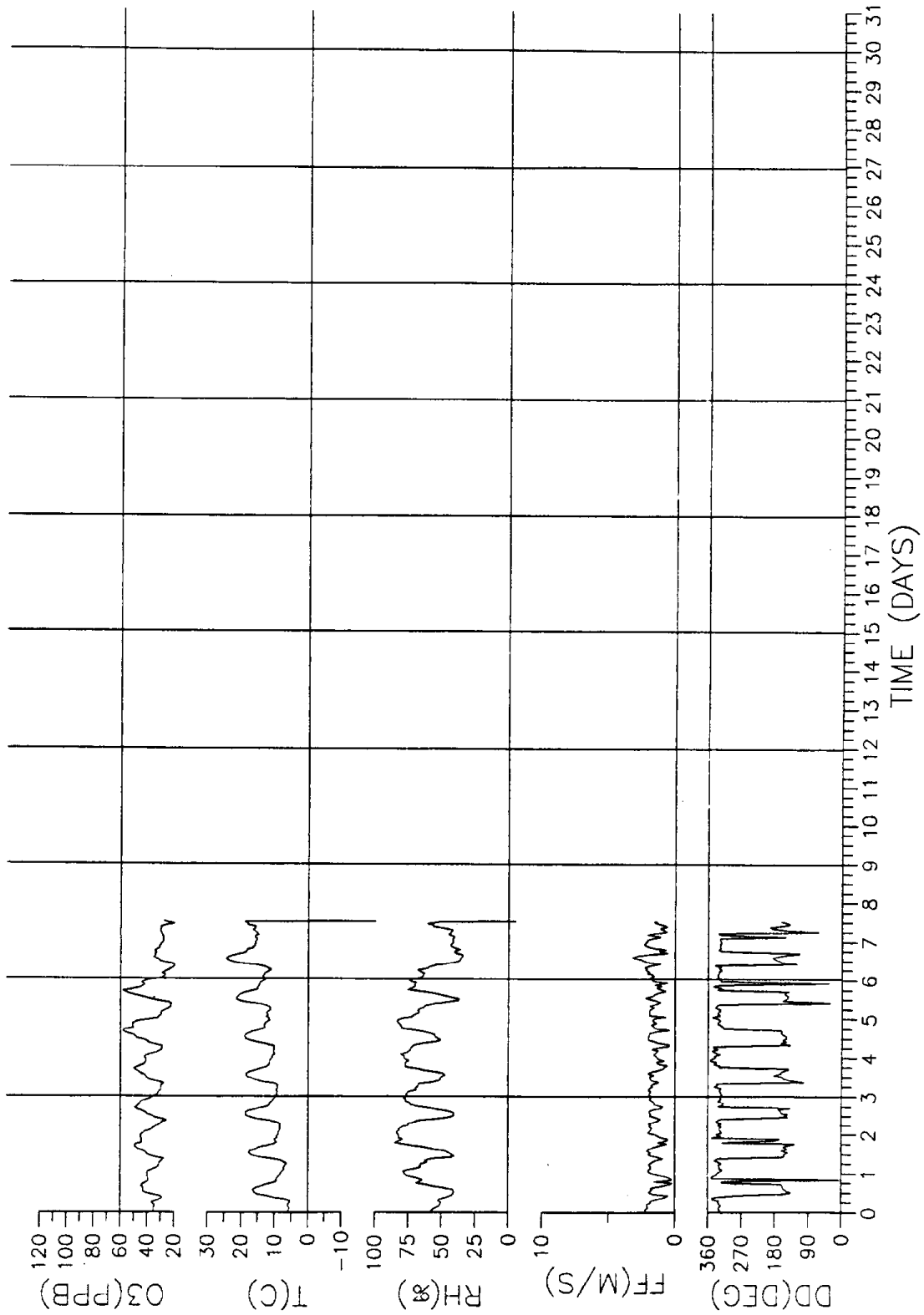


Figure 11(g)

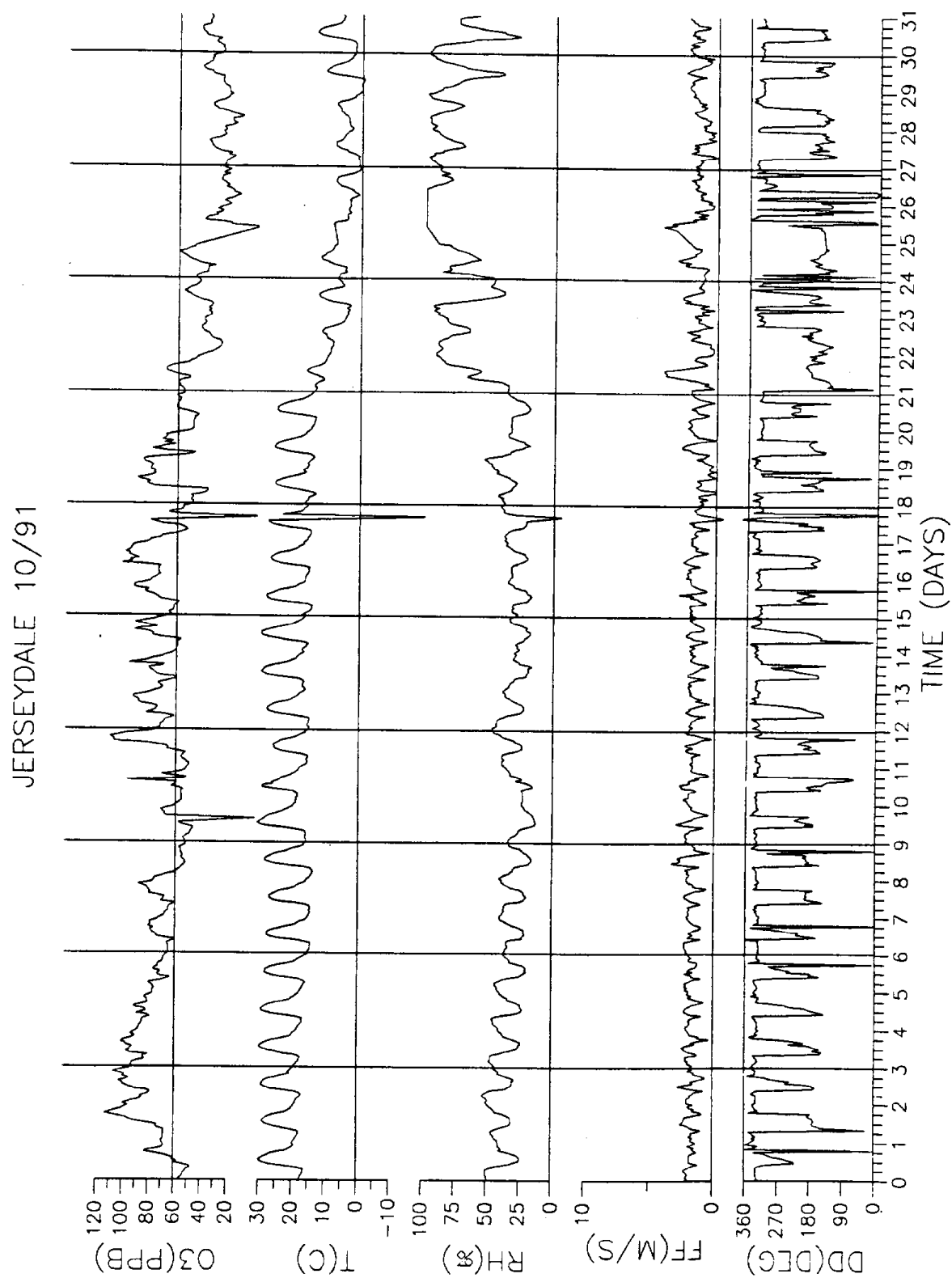


Figure 11(f)

FIVE-MILE LEARNING CENTER 6/91

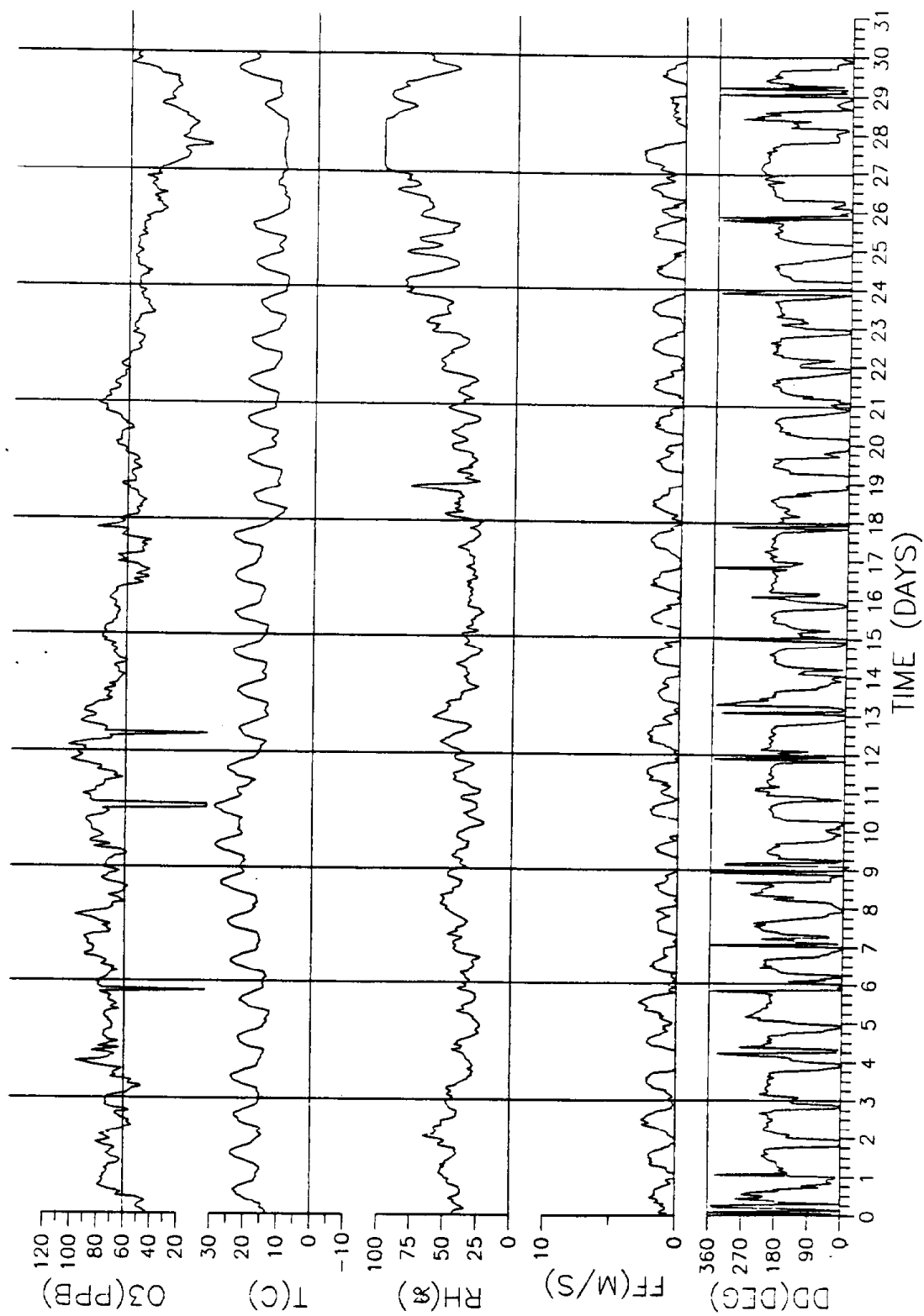


Figure 12(b)

FIVE-MILE LEARNING CENTER 5/91

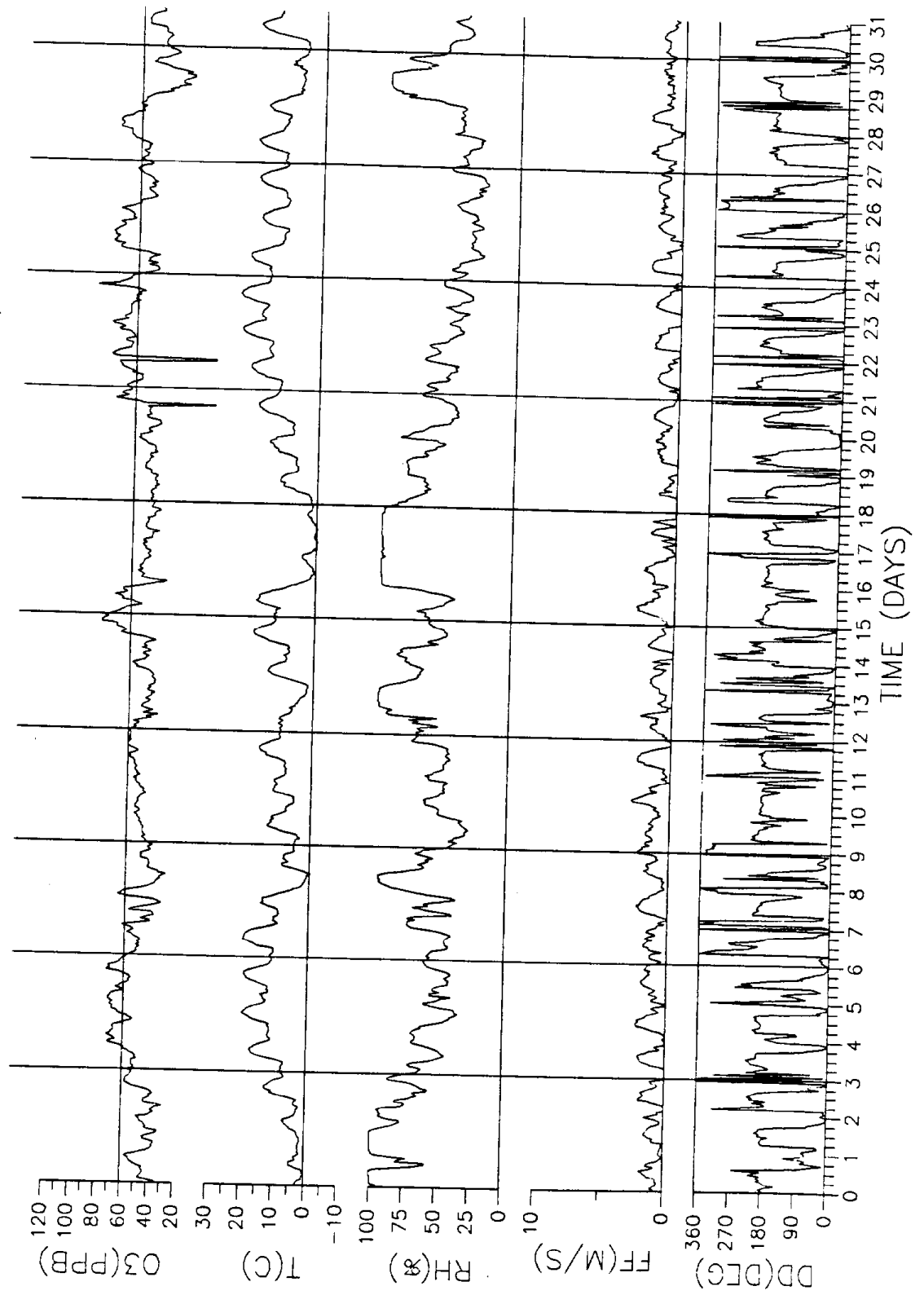


Figure 12. Same as 11, but for 5-Mile Learning Center.

FIVE-MILE LEARNING CENTER 8/91

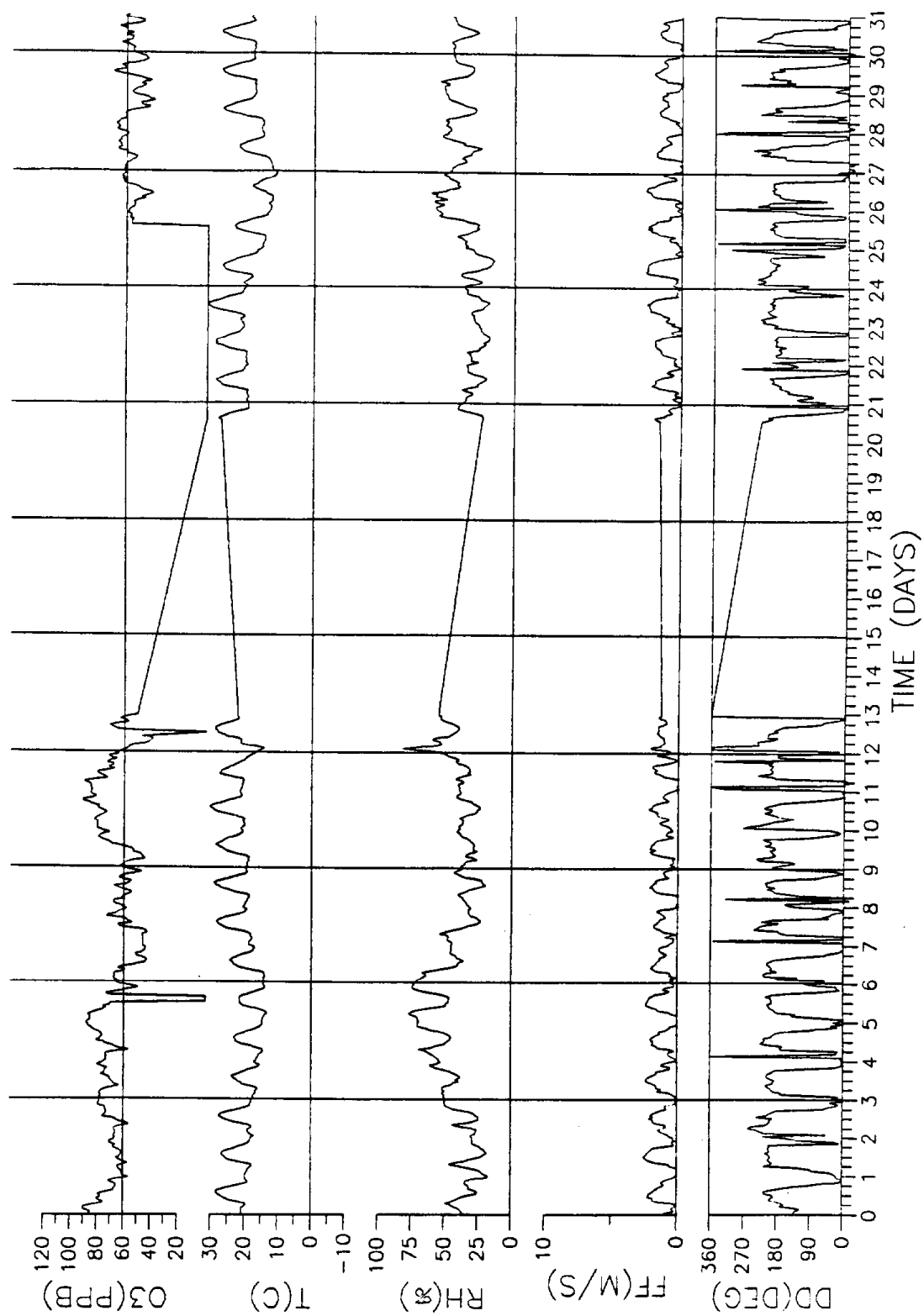


Figure 12(d)

FIVE-MILE LEARNING CENTER 7/91

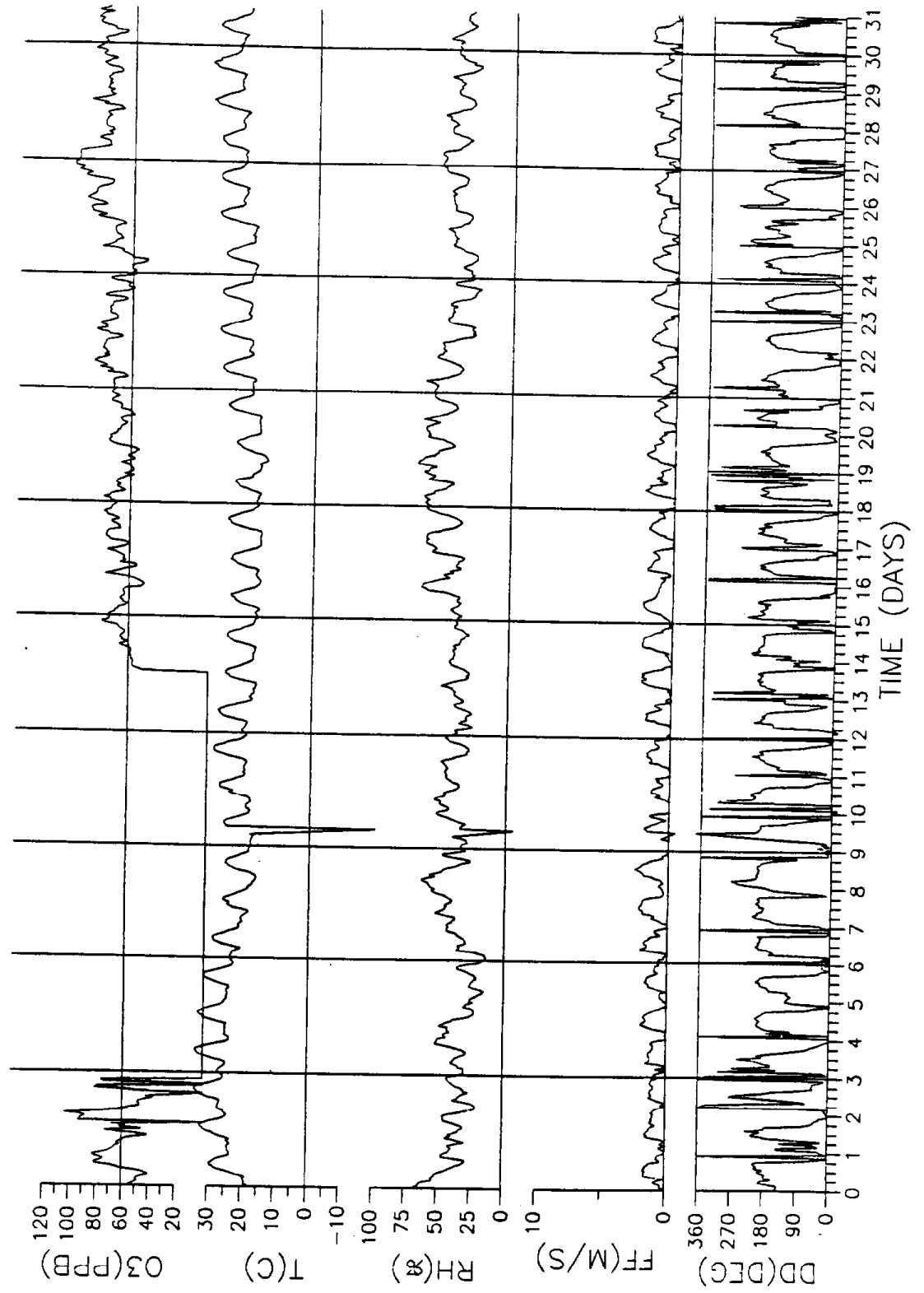


Figure 12(c)

FIVE-MILE LEARNING CENTER 10/91

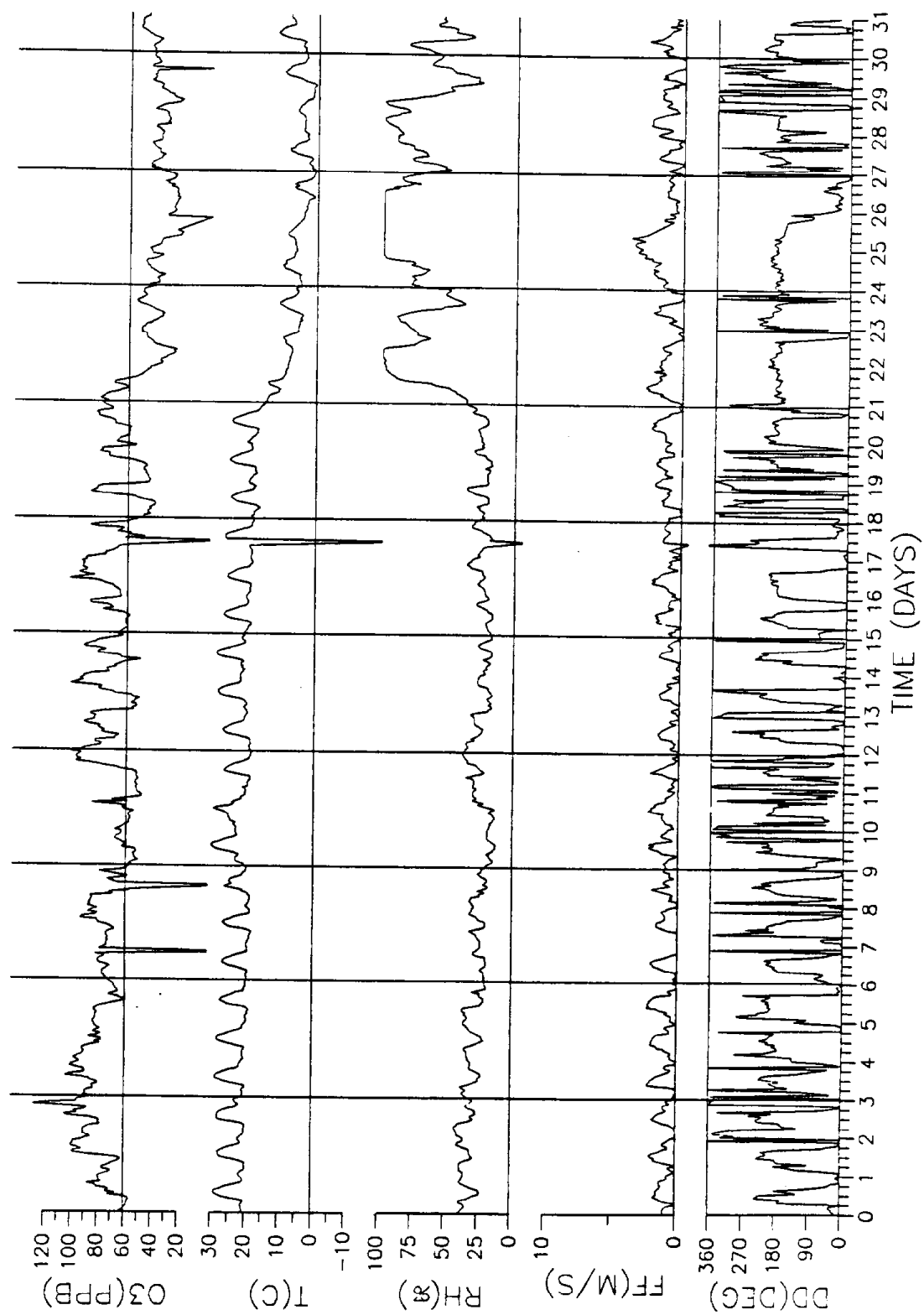


Figure 12(f)

FIVE-MILE LEARNING CENTER 9/91

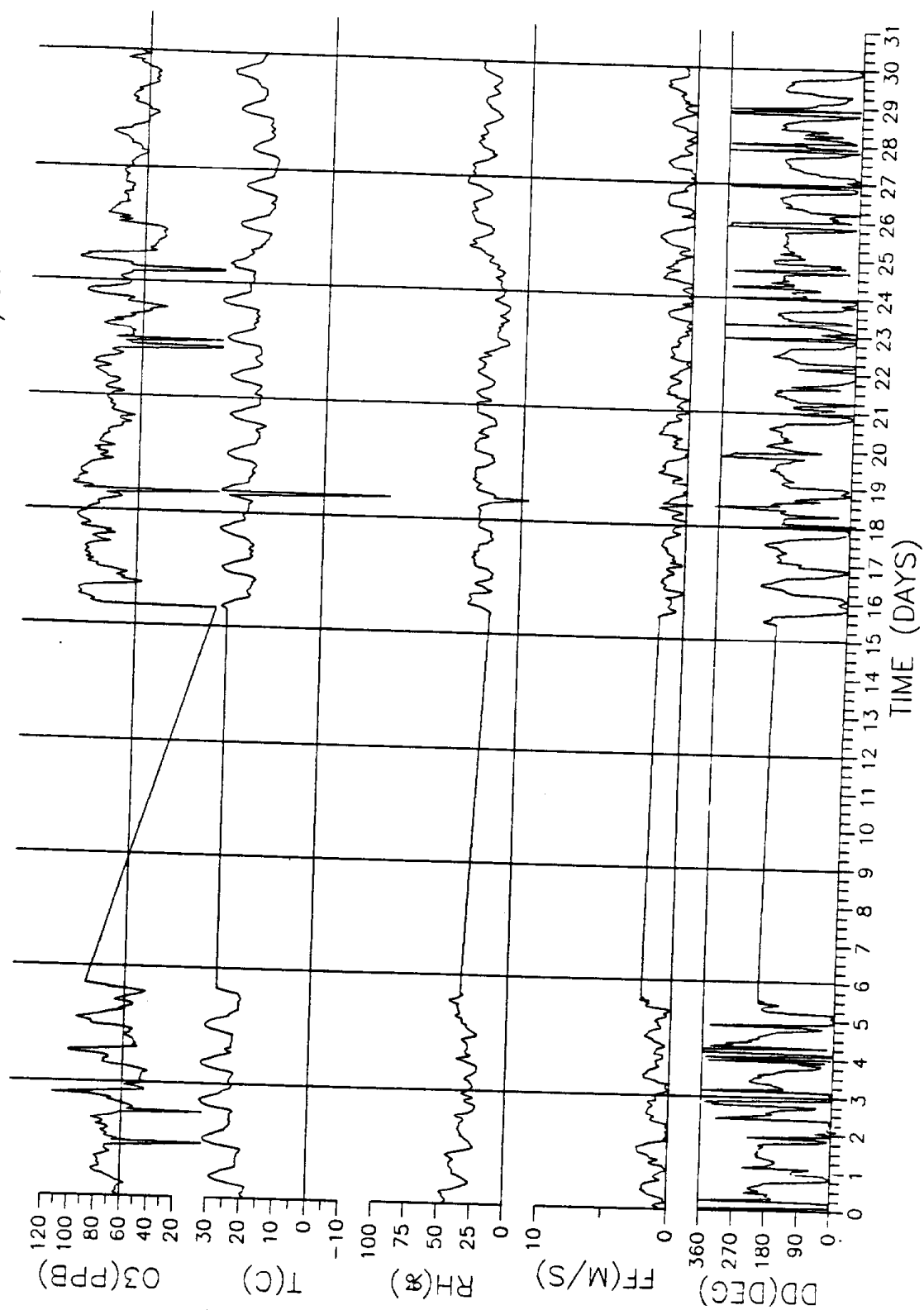


Figure 12(e)

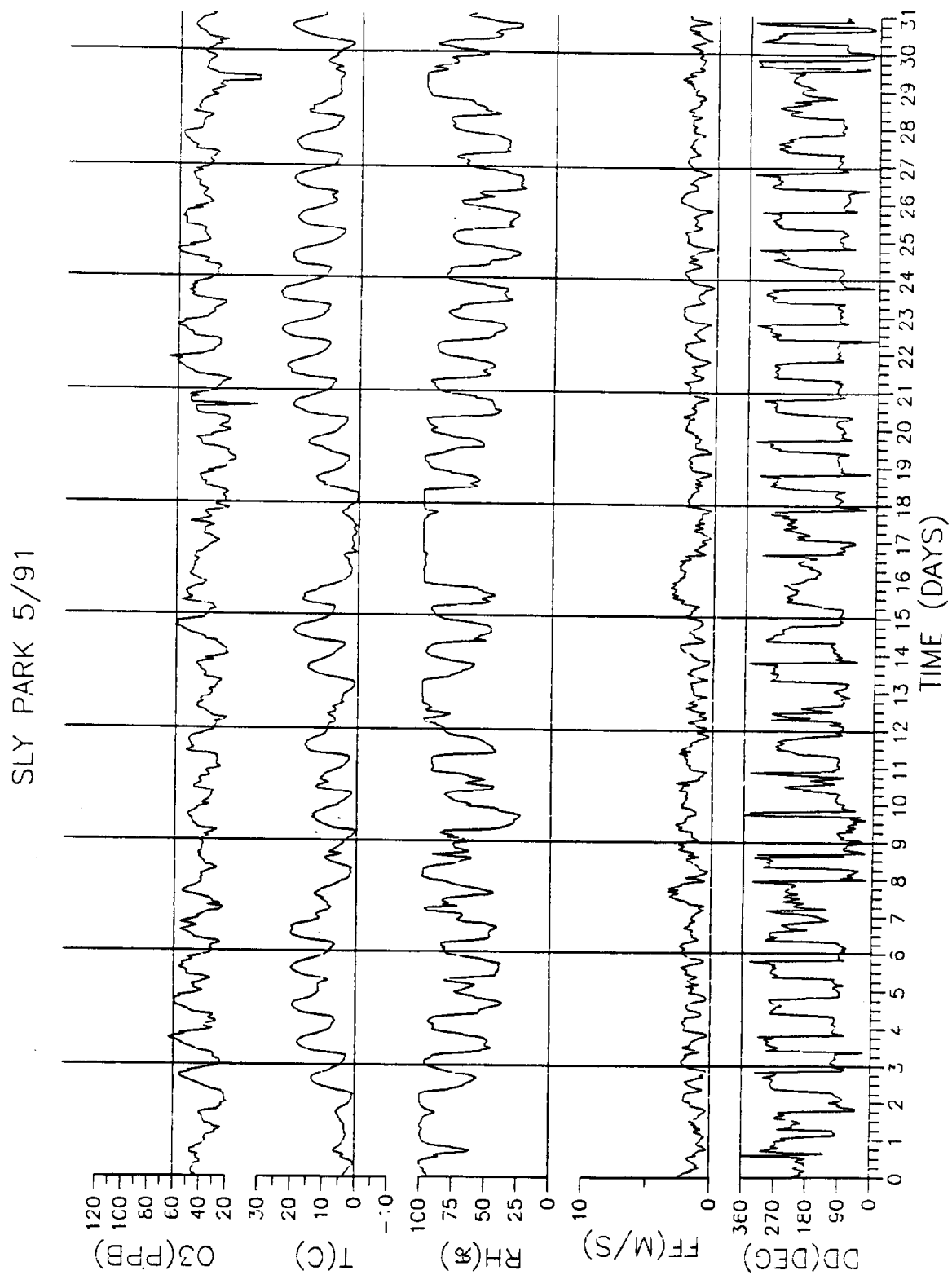


Figure 13. Same as 11, but for Sly Park Learning Center.

FIVE-MILE LEARNING CENTER 11/91

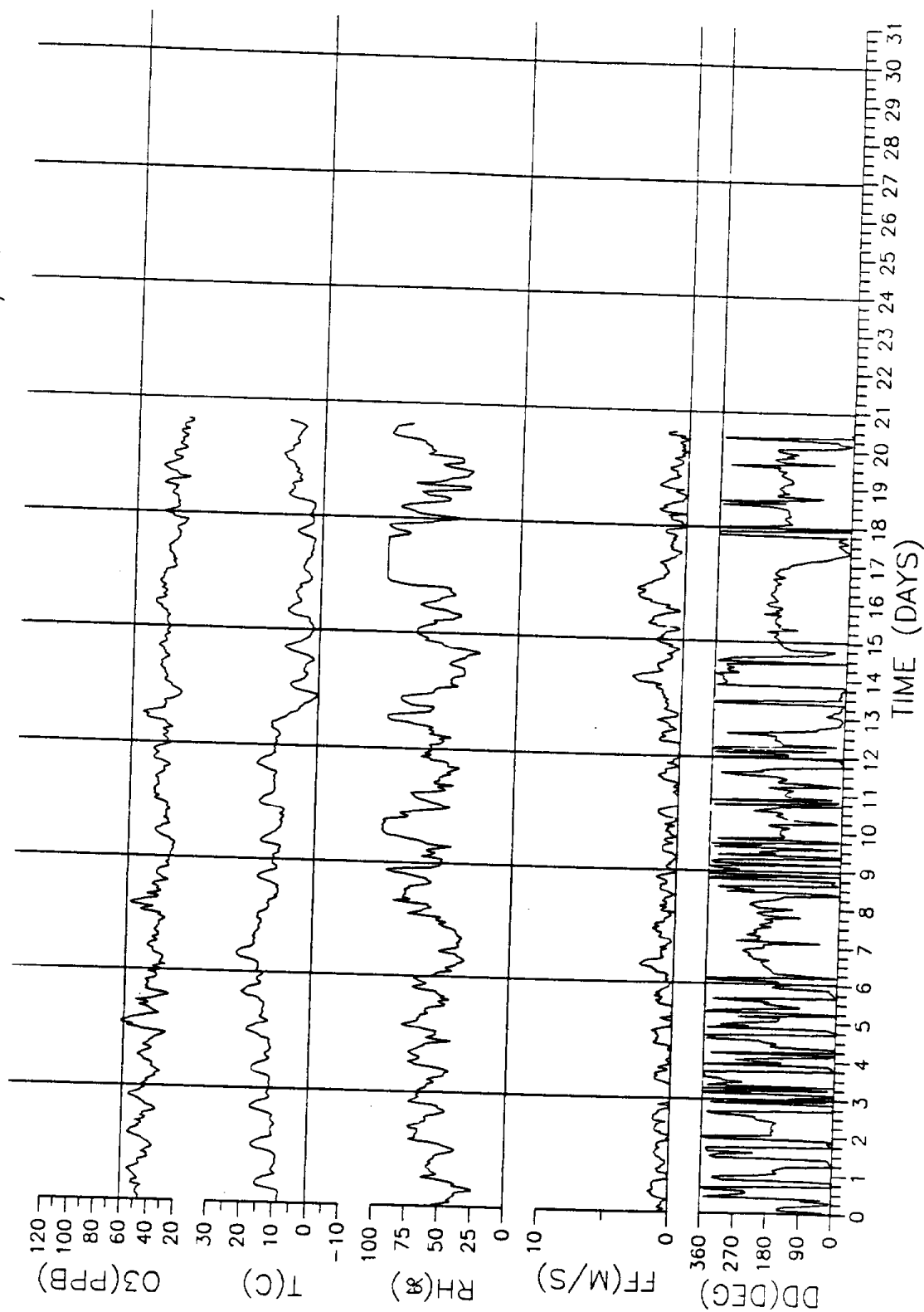


Figure 12(g)

SLY PARK 7/91

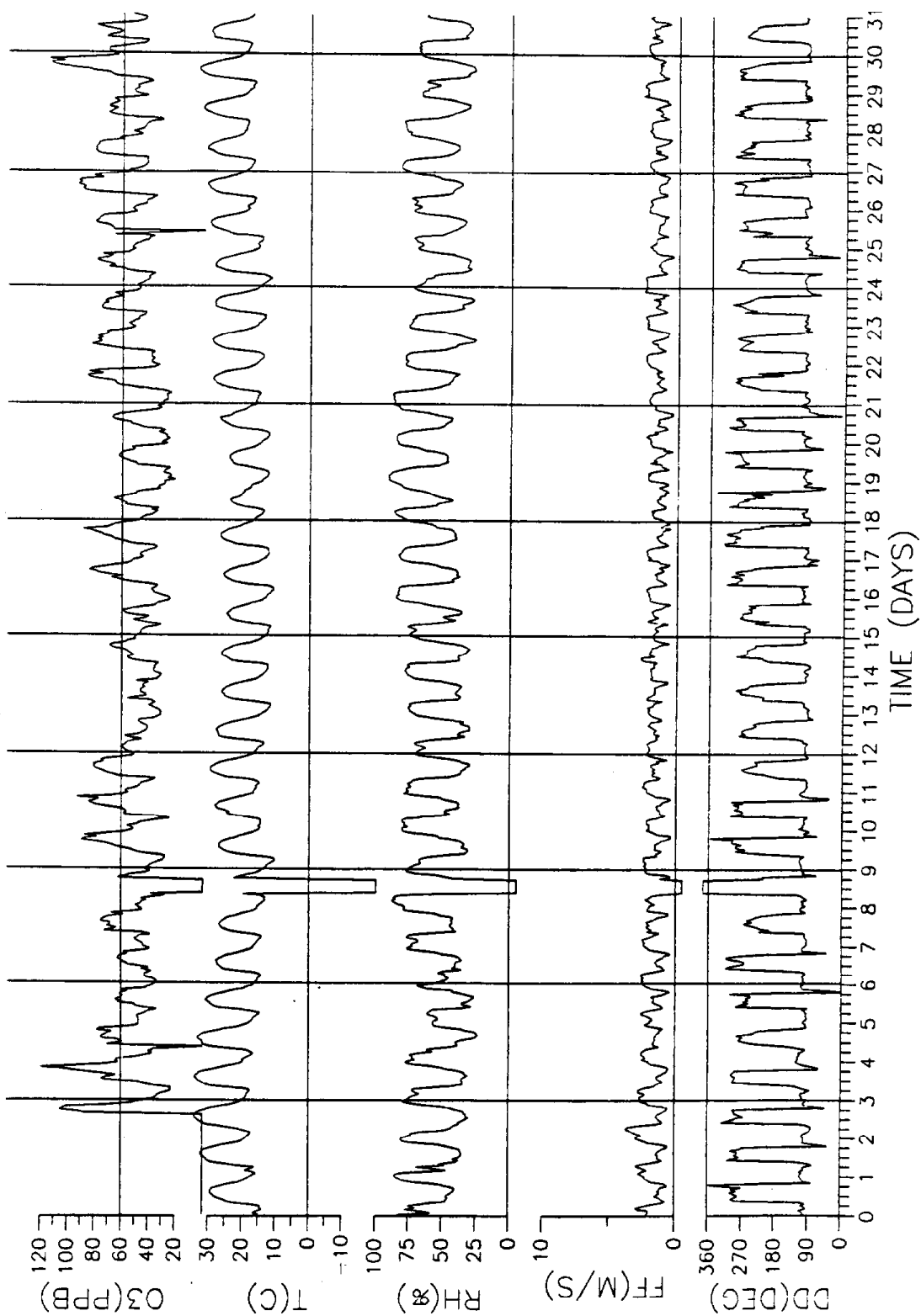


Figure 13(c)

SLY PARK 6/91

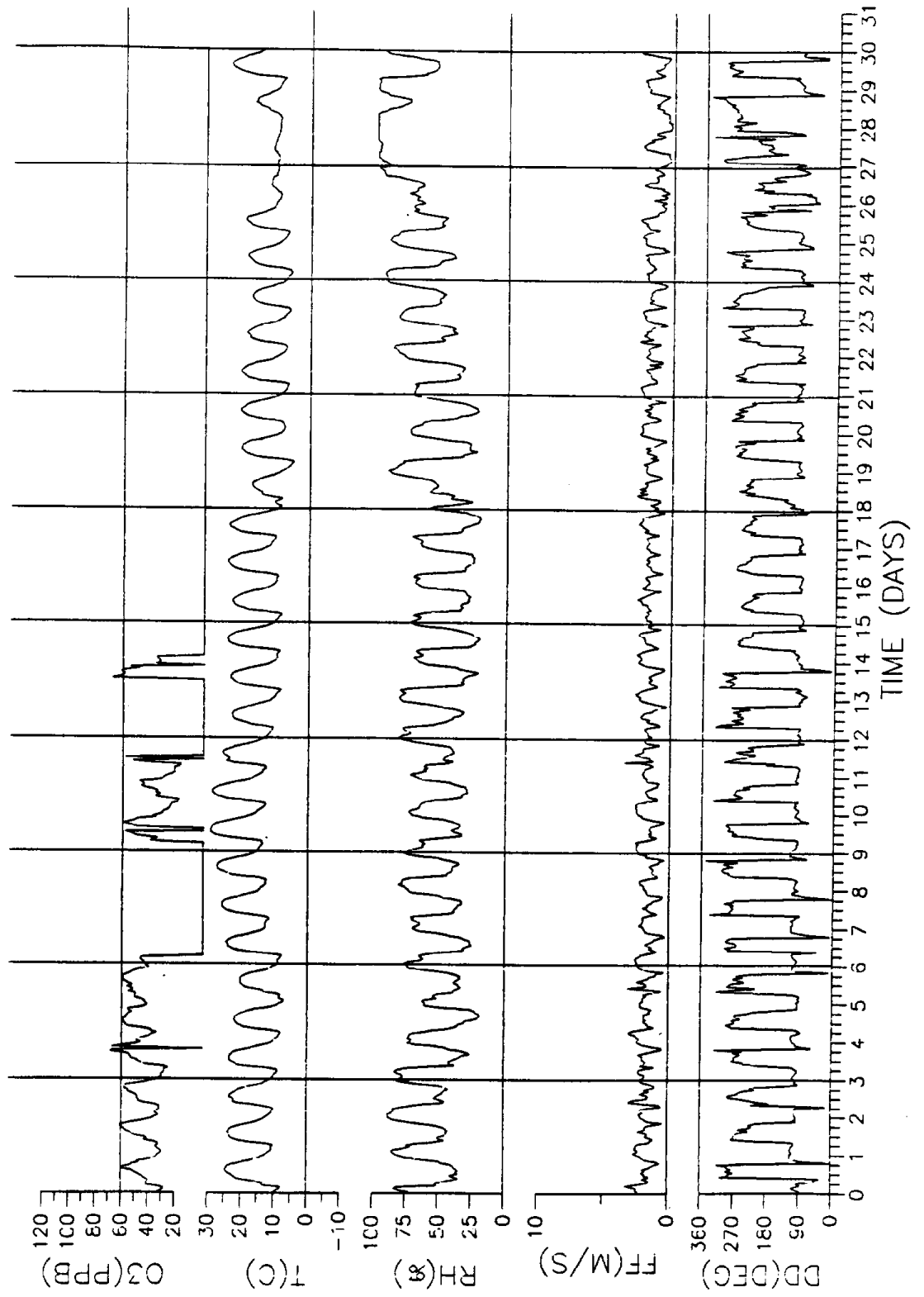


Figure 13(b)

SLY PARK 9/91

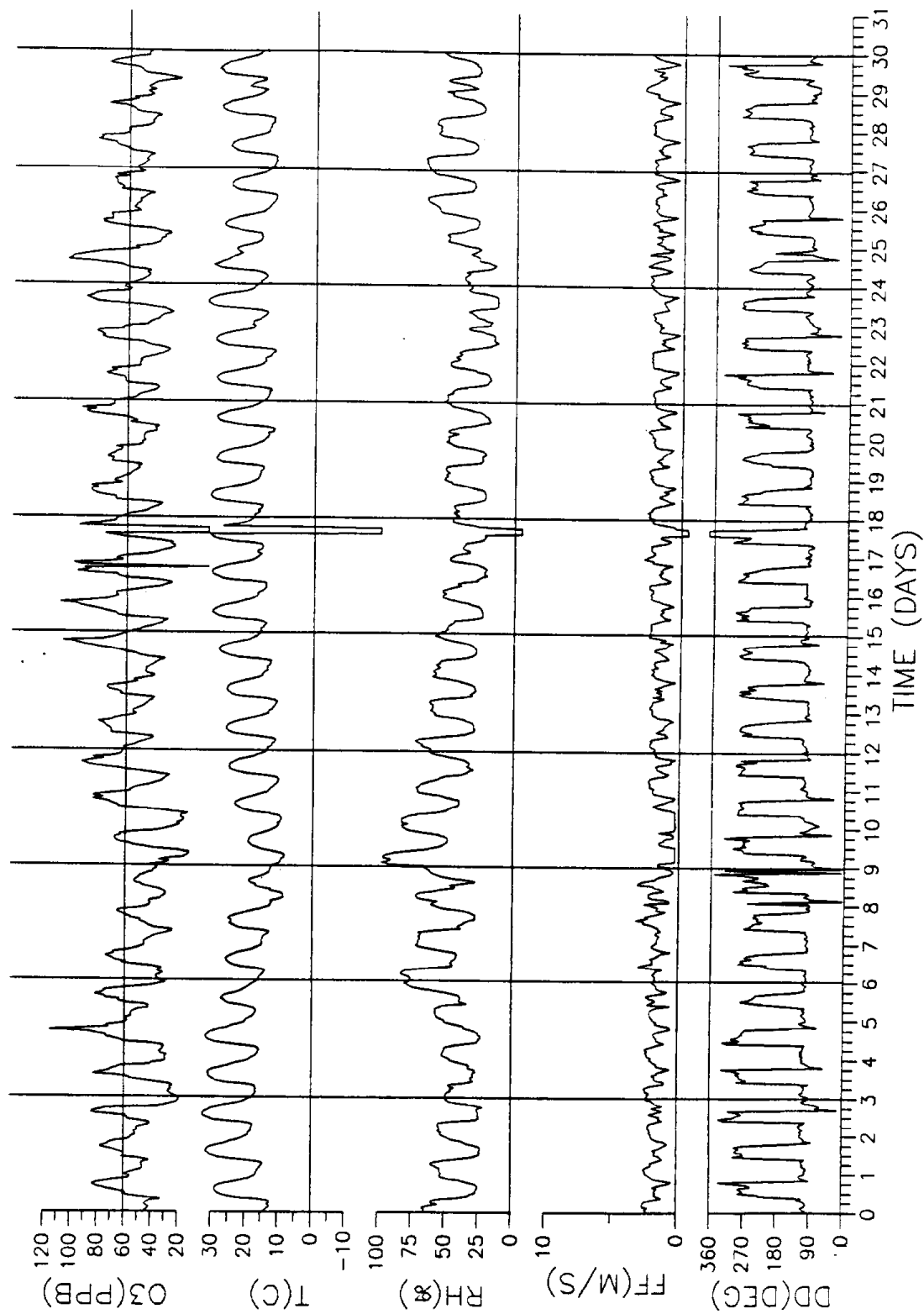


Figure 13(e)

SLY PARK 8/91

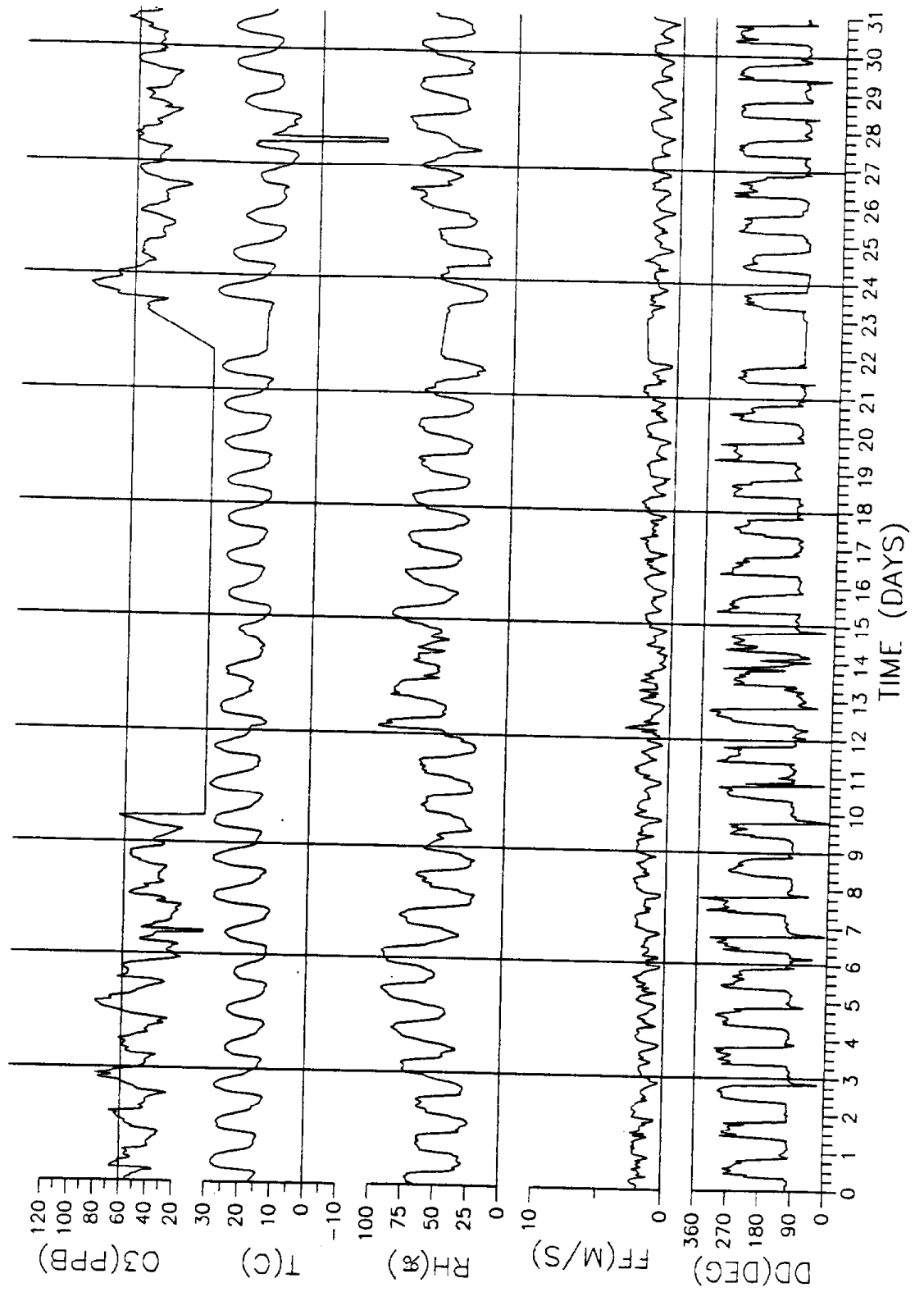


Figure 13(d)

SLY PARK 11/91

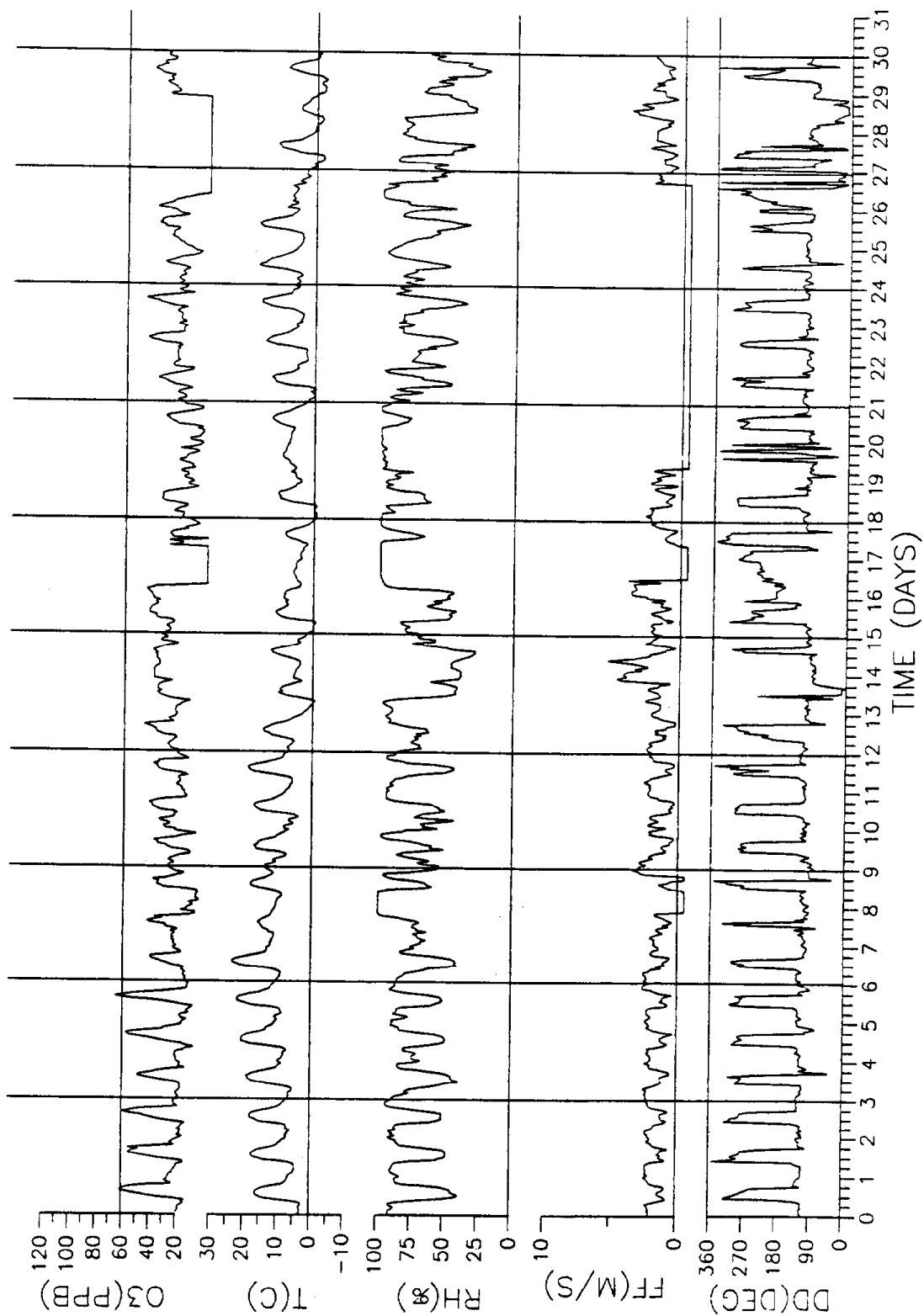


Figure 13(g)

SLY PARK 10/91

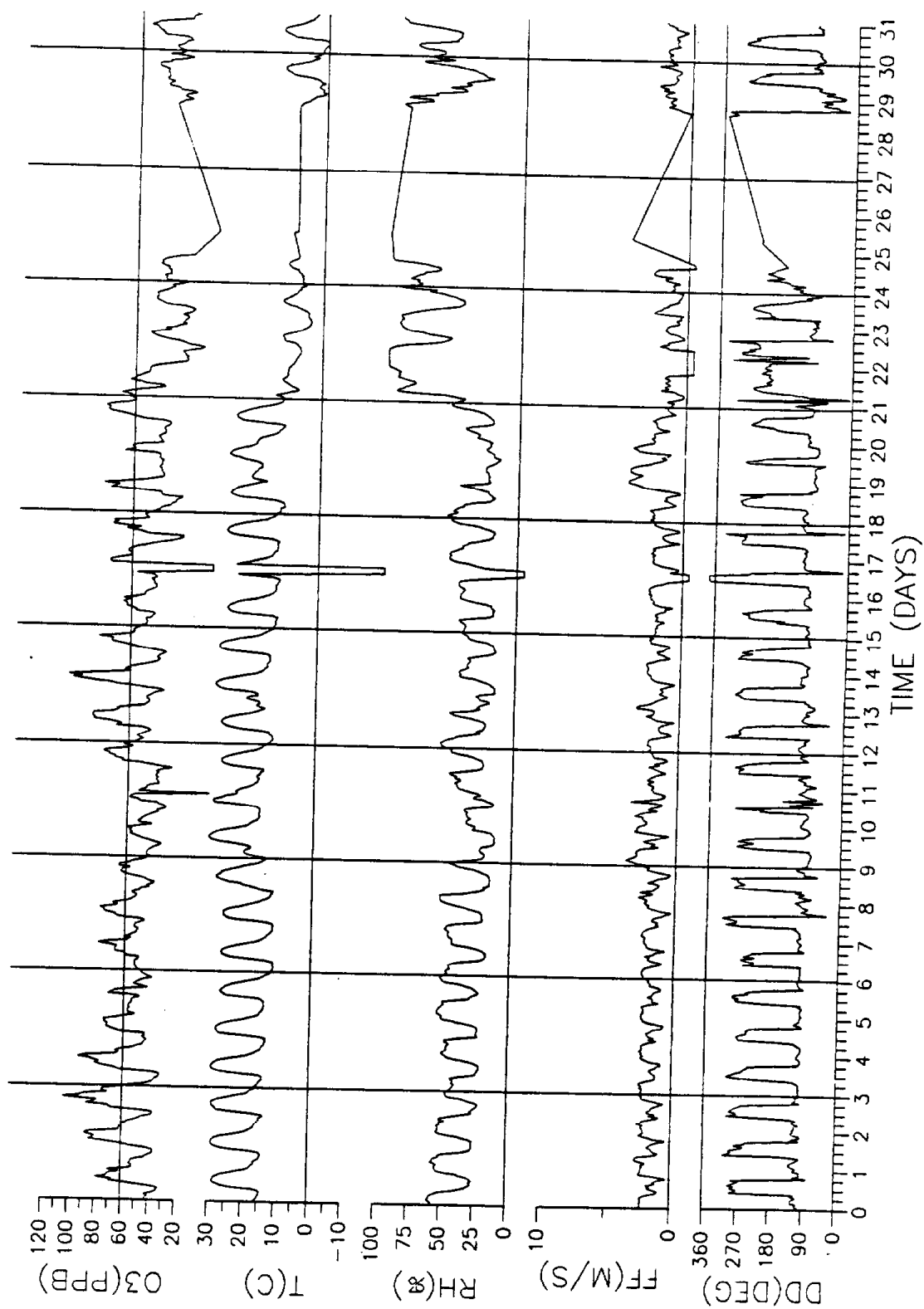


Figure 13(f)

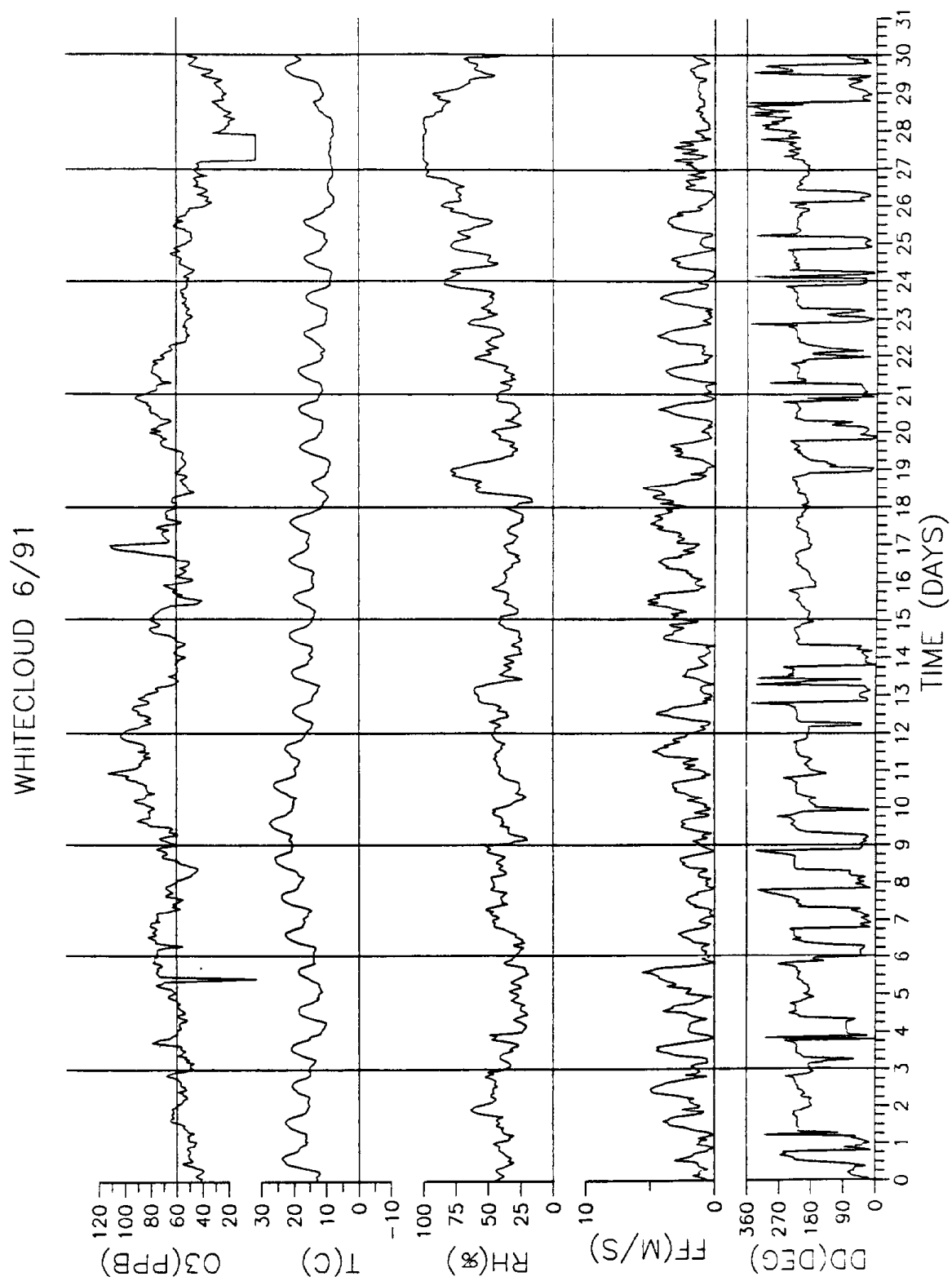


Figure 14(b)

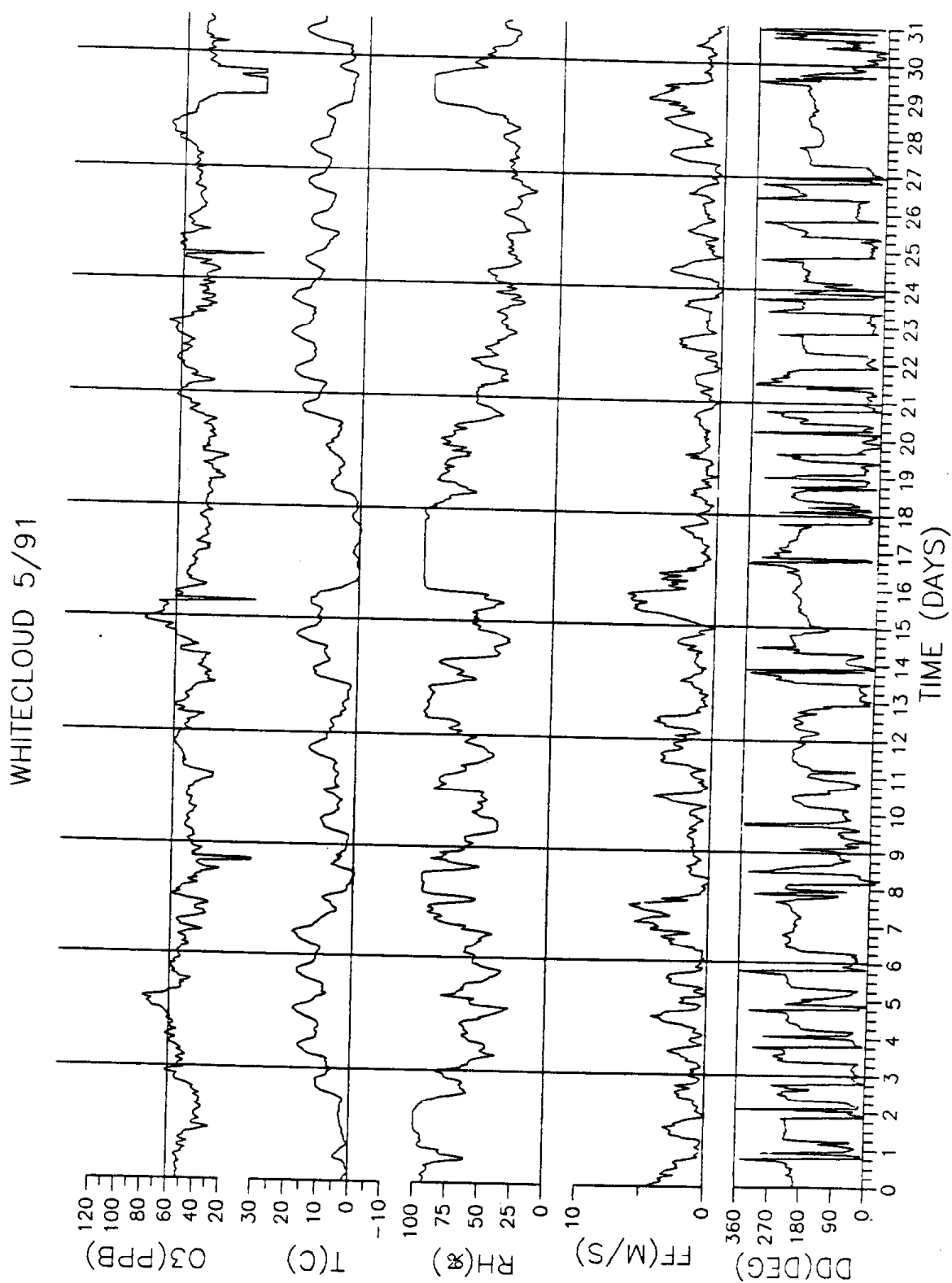


Figure 14. Same as 11, but for White Cloud.

WHITECLOUD 8/91

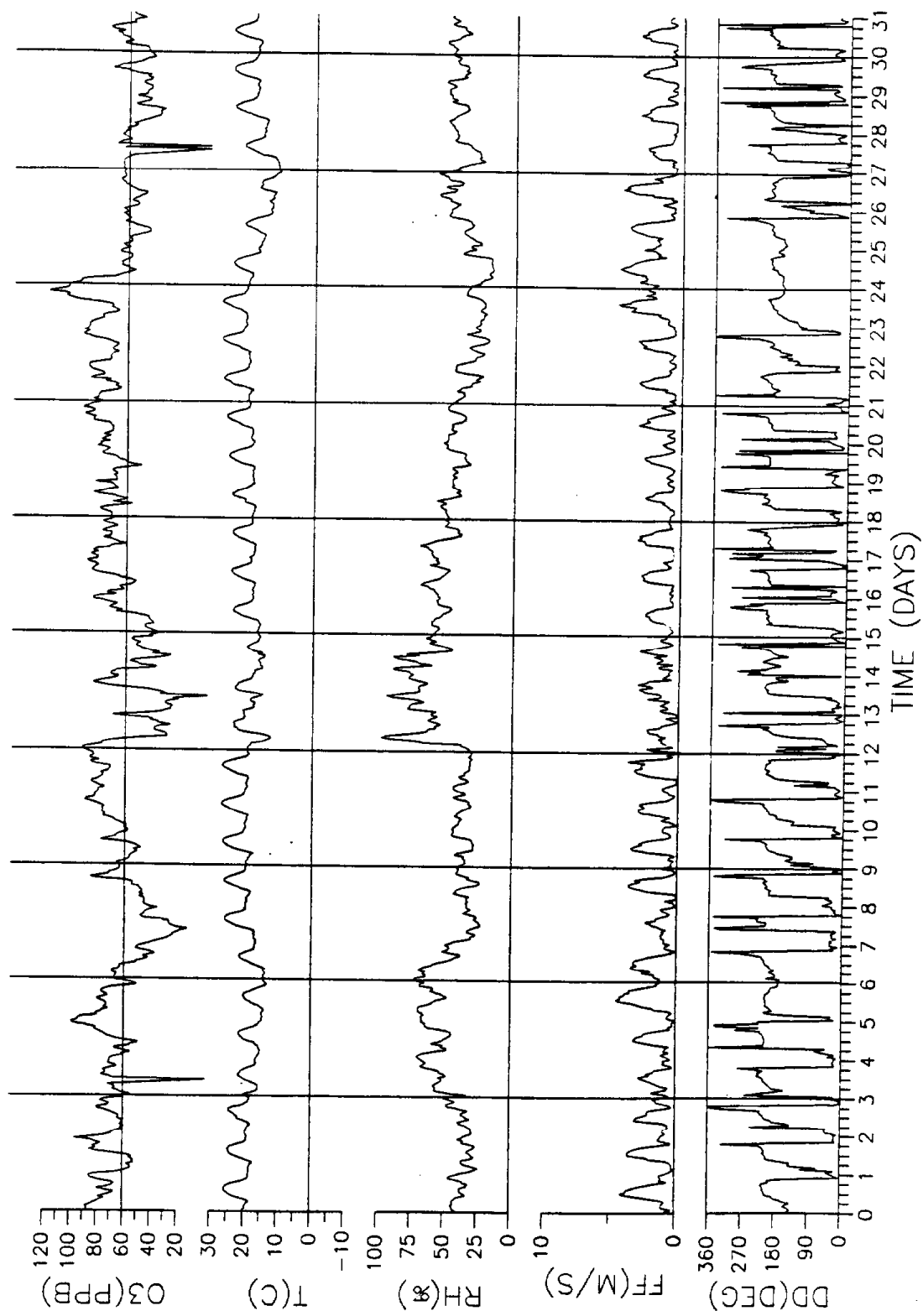


Figure 14(d)

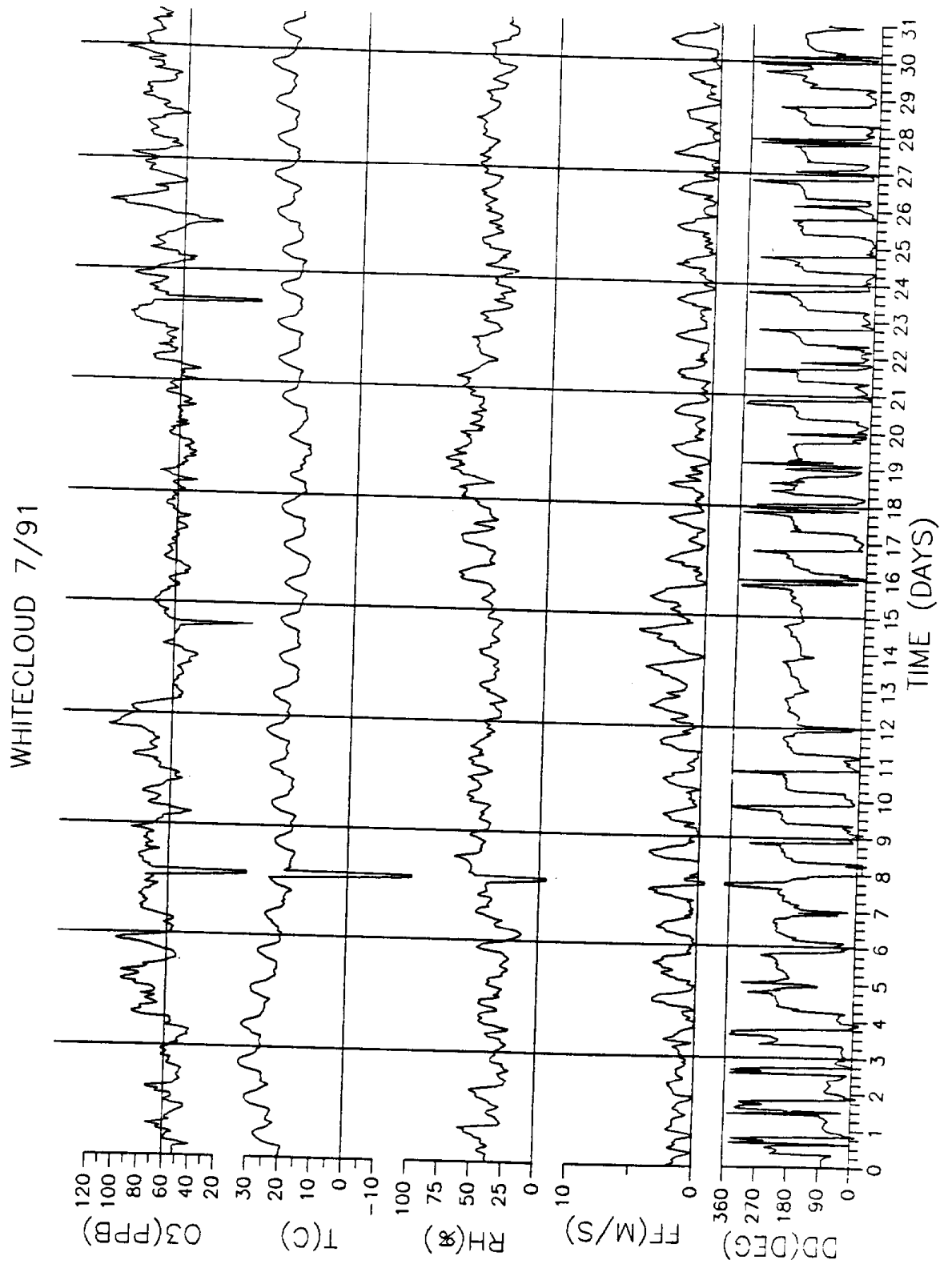


Figure 14(c)

WHITECLOUD 10/91

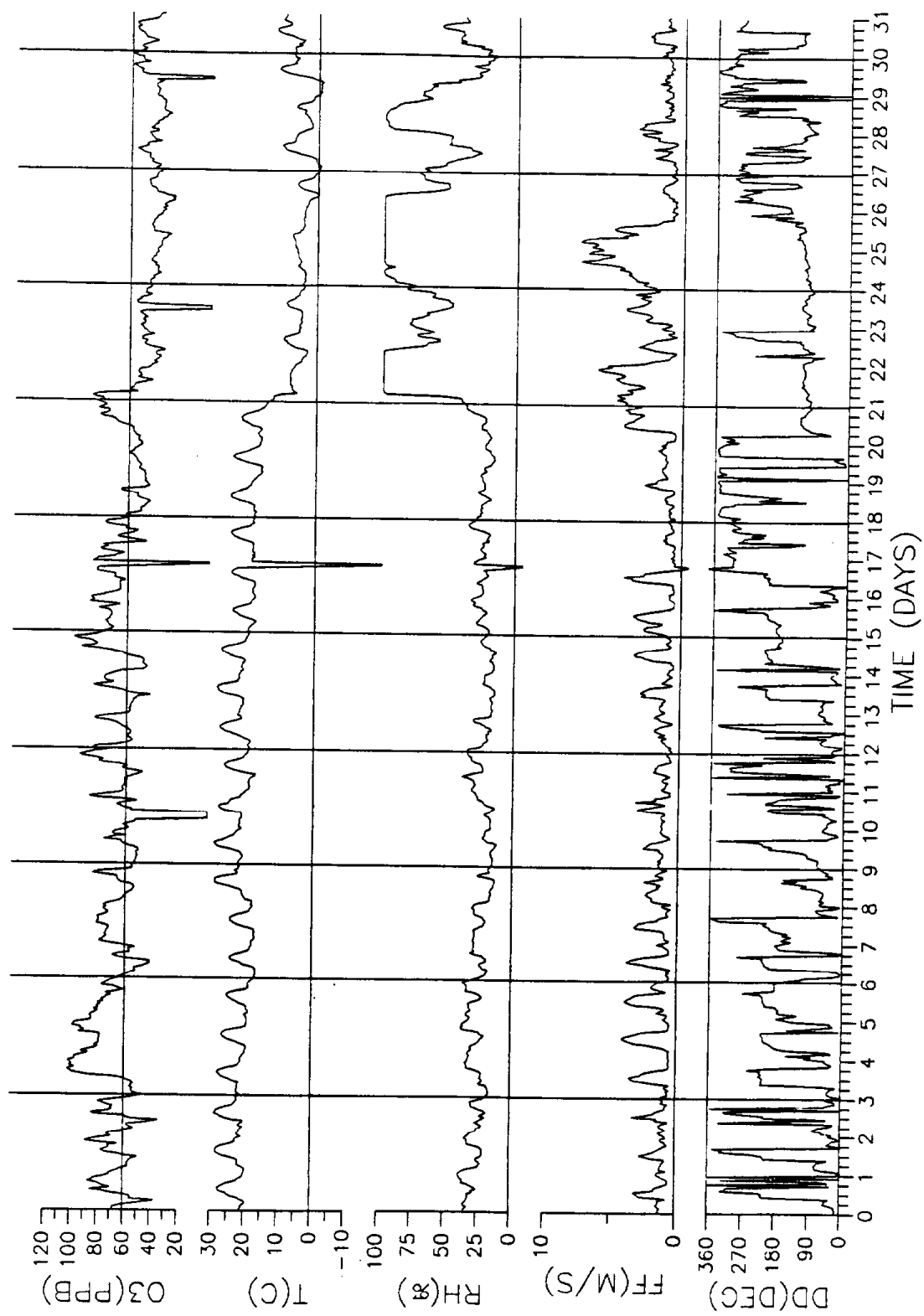


Figure 14(f)

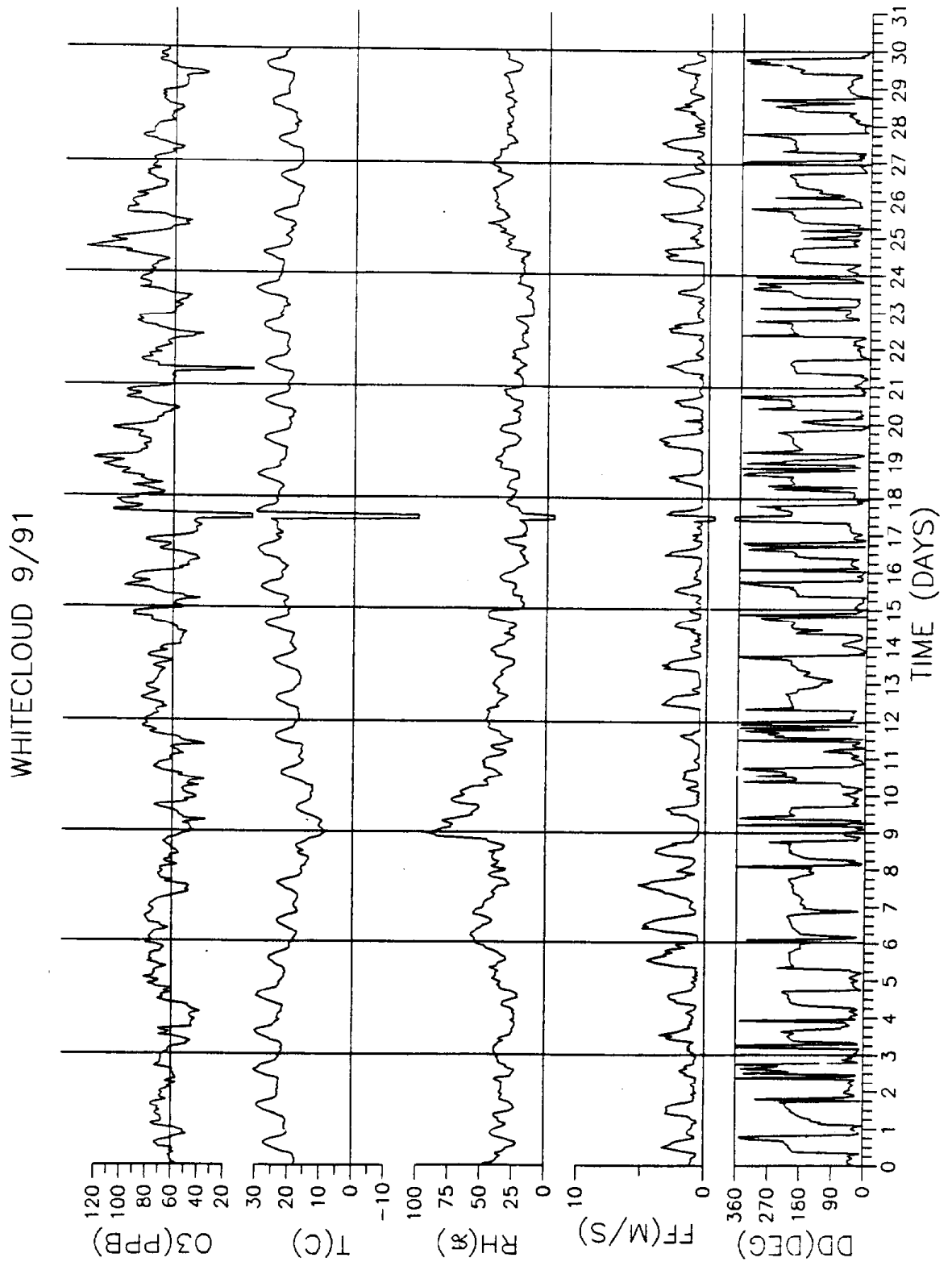


Figure 14(e)

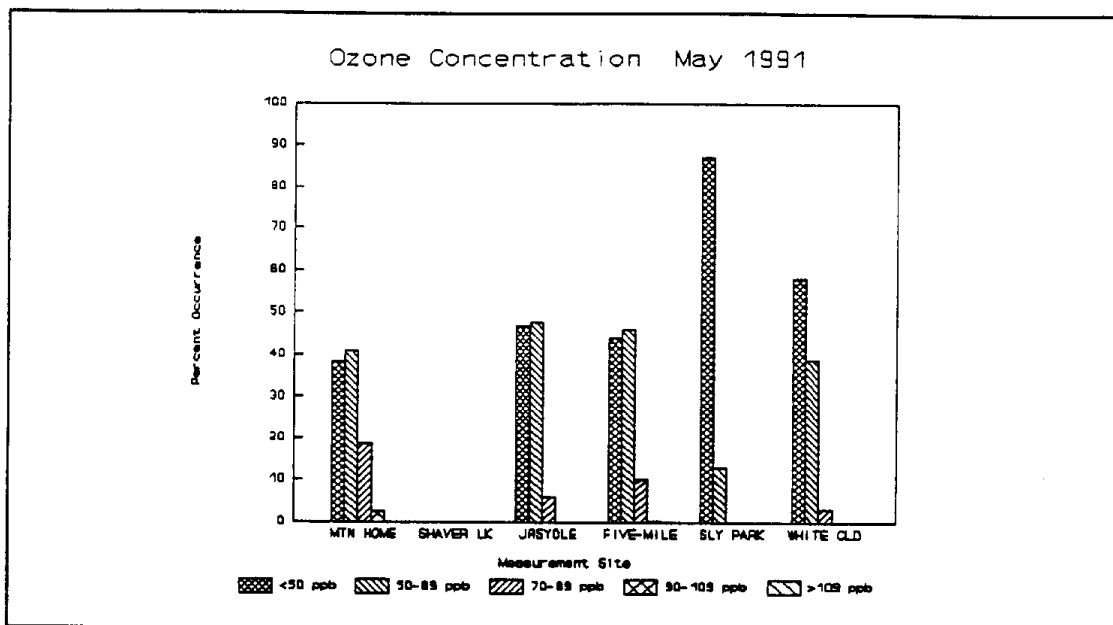


Figure 15. Frequency distribution of hourly ozone concentrations comparing the percent occurrence of concentration ranges among the six sites for the months of May (a) through September (e).

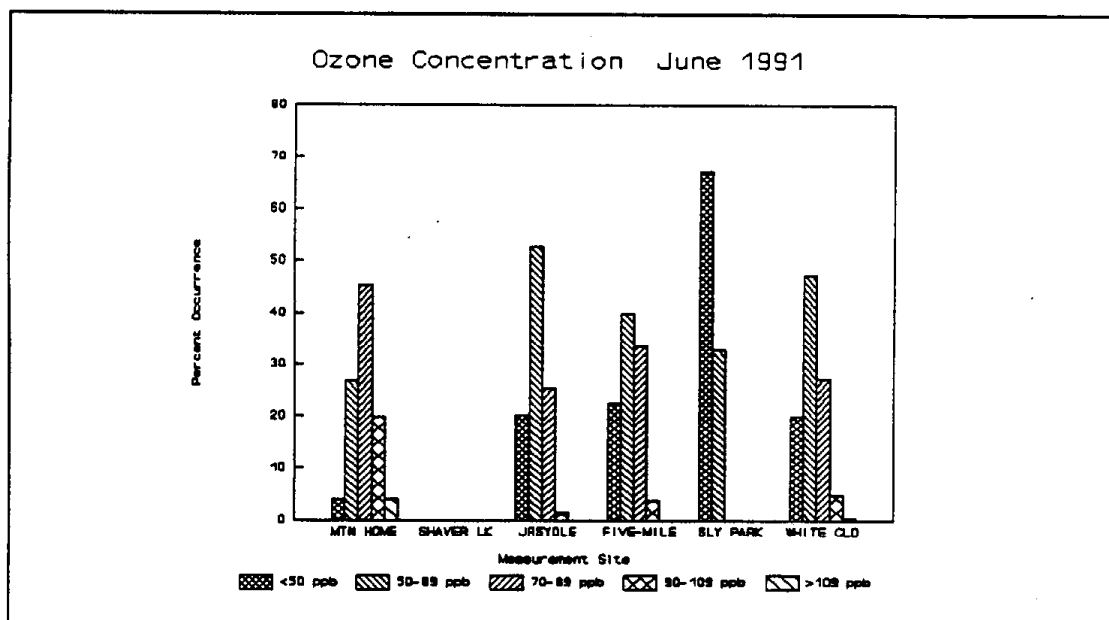


Figure 15(b)

WHITECLOUD 11/91

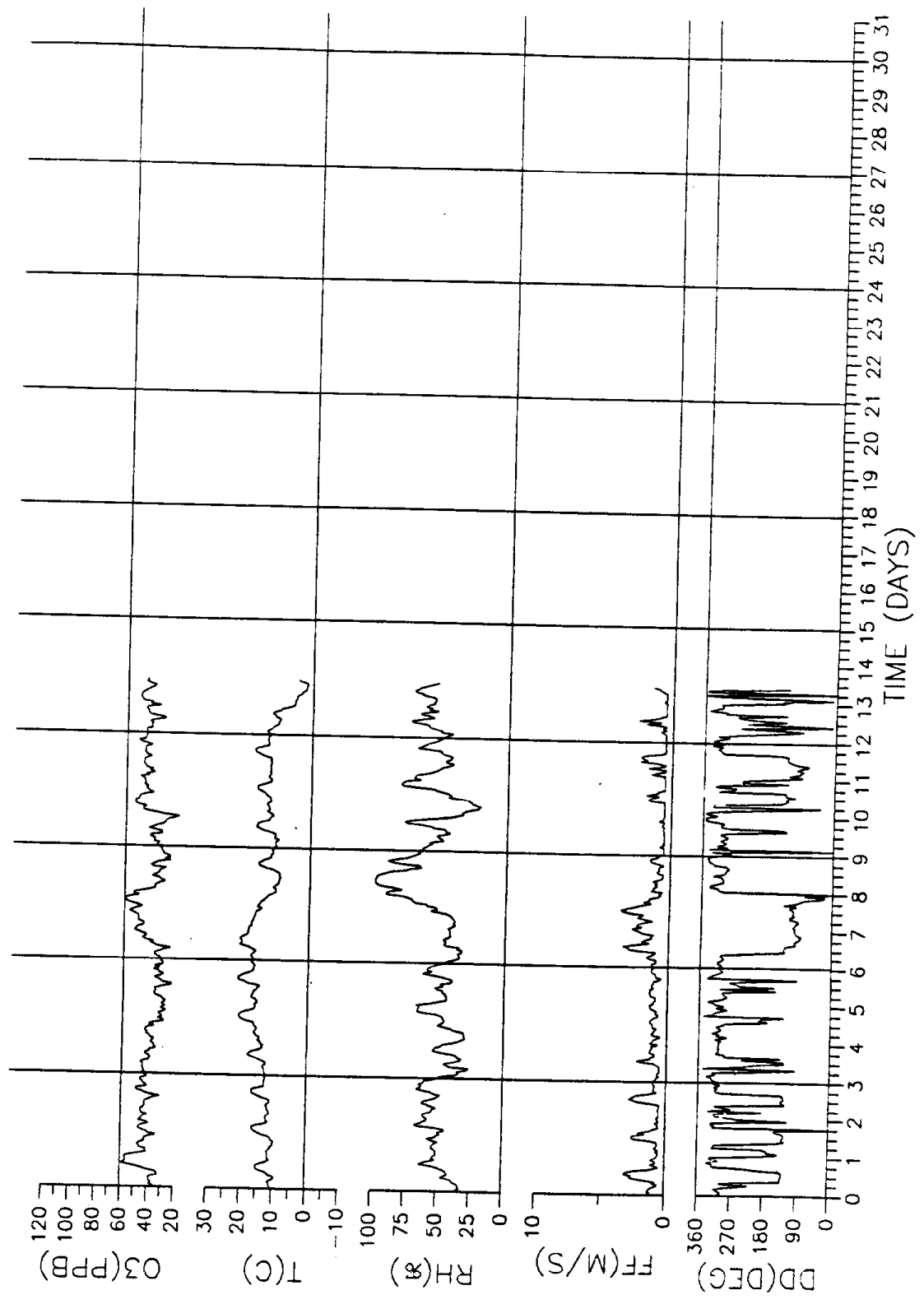


Figure 14(g)

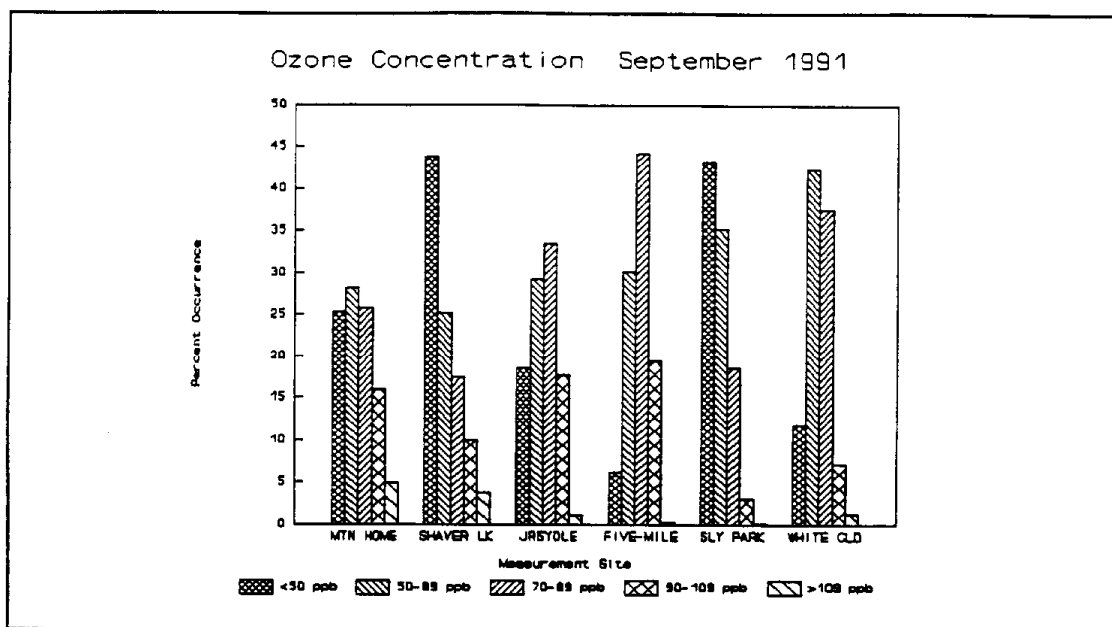


Figure 15(e)

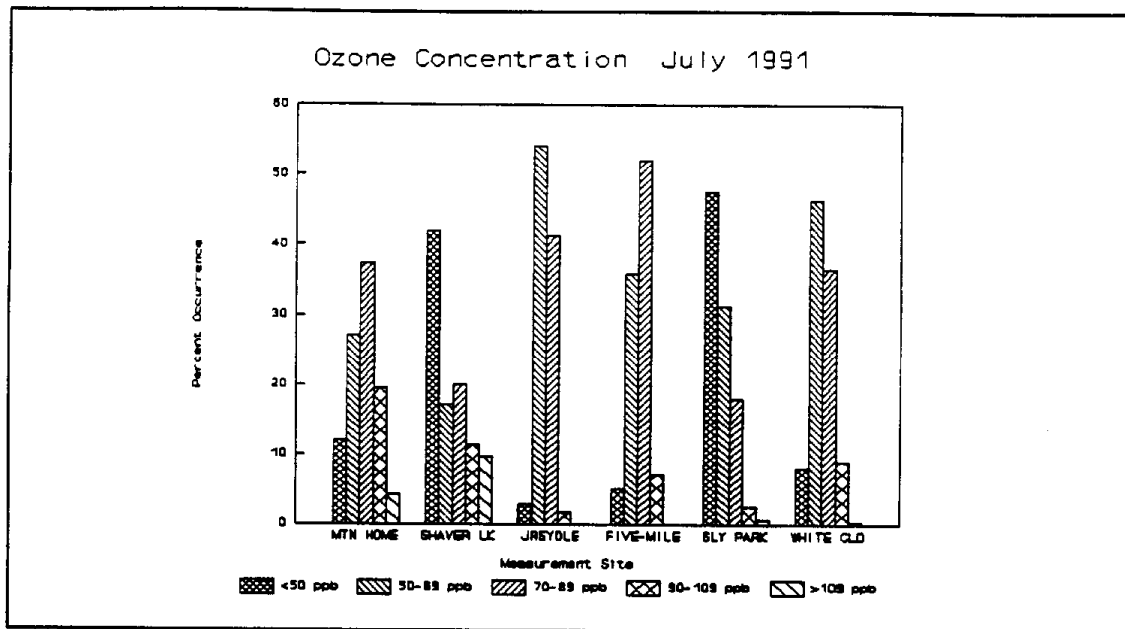


Figure 15(c)

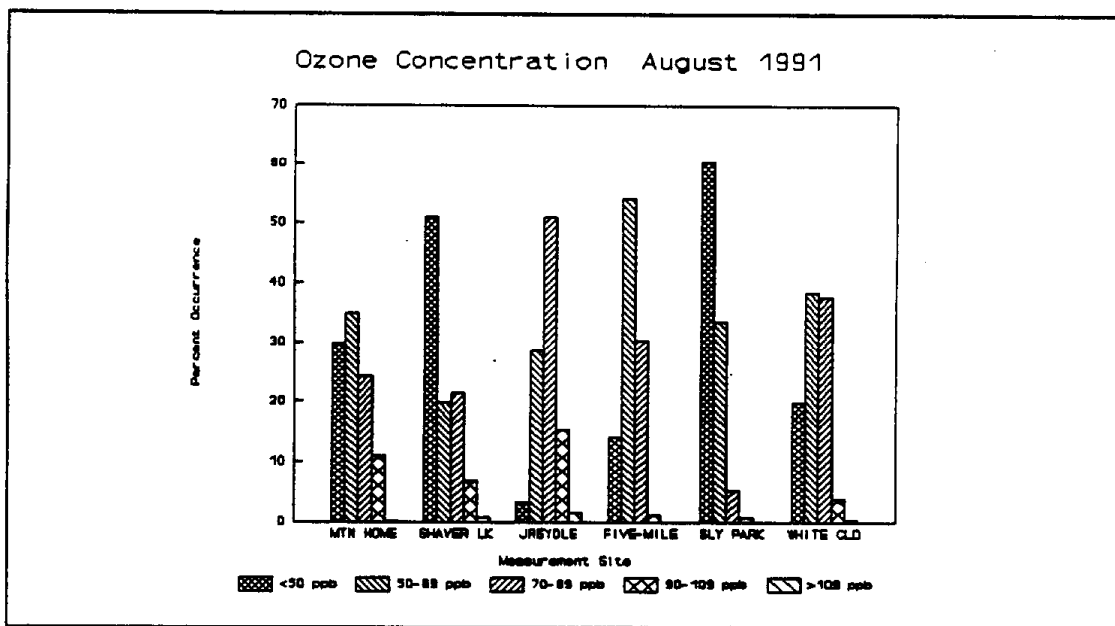


Figure 15(d)

APPENDIX A:

FIELD QUALITY ASSURANCE AUDITS
AND
DATA BASE DEVELOPMENT
FOR
THE U.C. DAVIS FIELD MONITORING PROGRAM
FINAL REPORT: YEAR 2

SUBMITTED TO
JOHN CARROLL
DEPARTMENT OF LAND, AIR AND WATER RESOURCES
UNIVERSITY OF CALIFORNIA, DAVIS

BY
KENNETH P. MacKAY
DEPARTMENT OF METEOROLOGY
SAN JOSE' STATE UNIVERSITY
SAN JOSE', CA 95192
(408) 924-5200

30 JUNE 1992

10 percent error. Wind instruments showed no apparent calibration problems. Temperature recordings were generally within 2 F of the transfer standard reading. Relative humidity readings differed from the transfer standard by less than 8 percent except for Mountain Home where the difference was 14 percent.

2.2 Audit Two

The second audit was performed during October 17-19. All data loggers recorded within 7 percent of the transfer standard input ozone concentrations. Wind instruments again showed readings within acceptable deviations from the appropriate transfer standard. Temperature errors were less than 2.5 F at all stations except Sly Park where it was 3.7 F. Relative humidity errors were less than 4 percent except at Mountain Home where it was 6.2 percent.

3. DATA PROCESSING

During the contract year 1990/91, SJSU developed a data handling and reporting procedure based on dBASE IV as requested by ARB and UCD. The package was complete and ready for beta testing. During July 1991 this protocol was scrapped in favor of a reporting system to provide data in standard, DOS compatible, ASCII format to allow data import to most popular spreadsheets.

The revised data summary and archiving tasks are as follows:

- A. Monthly printed summaries of hourly averaged data: resultant wind speed, resultant wind direction, temperature, relative humidity and ozone concentrations in format similar to ARB reporting.
- B. Monthly printed summaries of event distribution by wind direction. The tables would contain the percent frequency of occurrence of each wind direction octant and the average of the measured variables when the wind is in each of these octants.
- C. A high density PC-DOS or MS-DOS diskette with the temporally ordered hourly averaged data for each variable for each station and each month. These data will be in ASCII format with commas as separators between each variable. Each record will correspond to the time and each element in the record to the hourly averaged value of each variable.

ACKNOWLEDGEMENTS: Fernando Aluzzi and Brad Snook completed the field audits in 1991. Jack Molodanof and George Gatsios completed the computer programming and documentation. Isidora Mateu and Fernando Aluzzi prepared the case study. Matt Jackson and Brian Kahn have assisted in the preparation of this report. My thanks to all of them for their assistance.

1. INTRODUCTION

The University of California, Davis, Department of Land, Air and Water Resources (UCD) has installed a network of six stations to measure meteorological parameters and ozone along the western slopes of the Sierra Nevada. The San José State University, Department of Meteorology (SJSU) has contracted with UCD to (1) conduct a field quality assurance audit of network instrumentation to help insure the reliability of the data gathered, (2) to develop the software for a user-friendly data base of the measurements collected by this network, and (3) to identify a suitable case study and conduct meteorological analysis of the case. This report will summarize the progress made on completing the proposed tasks.

2. AIR QUALITY ASSURANCE AUDITS

Two field quality assurance audits were performed for UCD, one early in the measurement season and one just prior to network shut-down for the winter. The first audit took place in July and August of 1991 and the second during October. Two reports detailing the audit results have been submitted to UCD (MacKay, 1991; MacKay and Aluzzi, 1991).

2.1 Audit One

The first audit was performed over two separate time periods: July 8-11 and August 6,7. This schedule resulted from the fact that the Shaver Lake site was not installed until mid-July and two ozone monitors challenged during the early July audit were not working properly. SJSU then waited until the Shaver Lake installation had been operating for over two weeks and the ozone monitor malfunctions had been corrected and then completed the audit on August 6 and 7. The monitors at Sly Park and Five-Mile Learning Center showed errors of up to 30 percent while those at the other four stations were near or below an acceptable

Variable: Wind Direction (Degrees)

Date: October, 1991

Location: Min Home

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Peak Time
1	96	95	100	103	102	98	97	114	236	276	272	272	268	273	272	269	274	186	100	96	101	102	102	104	305 08:45
2	105	99	99	101	98	99	89	100	237	275	271	271	265	270	271	269	271	180	99	89	98	96	99	98	306 17:00
3	98	93	99	101	95	98	98	107	265	275	267	270	261	273	270	269	272	180	99	95	94	97	99	99	309 03:20
4	97	94	95	94	90	95	99	105	213	269	272	275	264	270	270	267	271	153	94	94	99	99	97	95	305 08:25
5	96	100	92	95	95	98	95	84	254	264	276	267	271	276	268	269	271	164	95	90	97	99	97	95	350 08:05
6	96	96	103	96	97	99	97	87	190	259	271	273	279	266	267	273	271	105	95	95	95	101	95	96	356 10:45
7	95	102	99	90	91	93	100	110	181	257	273	273	272	273	271	271	270	107	95	91	91	95	100	94	301 11:25
8	94	96	92	92	97	98	97	95	106	208	259	267	271	272	270	265	264	150	90	90	92	85	87	87	351 09:50
9	85	81	86	90	92	96	99	104	141	171	133	141	261	270	262	274	261	143	79	70	99	150	95	84	521 07:25
10	104	117	97	99	100	120	74	172	111	208	177	165	275	275	265	276	173	150	108	64	55	95	96	71	582 22:05
11	76	65	72	95	85	80	39	84	102	110	111	175	271	275	163	271	271	107	90	96	85	101	95	95	330 15:05
12	95	96	91	92	99	97	175	196	259	248	271	271	270	273	271	271	268	164	95	95	98	91	100	95	358 06:25
13	95	94	94	90	94	85	86	95	259	274	271	260	274	269	265	271	270	154	94	100	97	101	90	96	354 08:15
14	100	98	95	99	97	99	161	121	205	269	263	264	267	267	271	269	272	98	101	97	97	99	99	99	357 07:45
15	100	96	91	94	100	105	77	101	175	269	264	264	267	271	271	271	267	126	111	7	45	94	96	95	296 17:10
16	98	101	97	95	95	97	90	105	195	255	277	271	271	271	273	271	271	111	97	97	94	92	94	90	357 03:25
17	100	97	95	92	97	95	96	104	164	265	270	275	273	273	275	264	272	99	96	92	96	100	98	95	300 12:30
18	99	99	99	101	94	96	97	90	196	279	274	274	274	273	270	273	272	110	95	96	96	95	99	96	514 04:35
19	97	101	95	96	99	93	100	130	169	279	269	271	271	271	273	273	273	91	81	100	94	96	97	82	513 07:15
20	70	79	80	81	87	82	82	91	137	227	269	255	270	261	272	273	273	100	85	87	94	91	95	91	260 10:35
21	92	87	96	95	99	97	95	112	212	271	273	272	275	274	274	272	275	139	92	93	85	94	91	95	307 17:10
22	95	85	137	92	80	74	90	114	250	276	275	276	275	277	271	276	270	279	279	276	270	107	189	220	353 23:05
23	93	87	272	275	287	205	289	287	273	290	295	283	280	287	271	275	276	279	279	277	277	273	101	85	337 22:55
24	99	99	87	95	62	55	246	291	259	274	275	290	274	275	277	271	272	186	92	92	92	91	91	96	337 07:00
25	95	75	95	92	94	96	219	156	278	264	245	262	265	257	270	270	270	100	95	97	85	126	97	112	354 23:25
26	90	96	151	196	166	197	259	303	285	281	262	262	284	281	280	287	293	290	294	297	297	292	296	305	357 06:10
27	305	303	295	294	295	296	295	297	296	293	291	295	294	292	289	290	293	293	302	301	291	303	313	309	341 22:55
28	318	304	302	311	263	188	104	248	320	315	297	265	288	272	291	255	307	153	90	90	90	93	102	102	359 17:25
29	100	99	117	88	95	215	285	282	270	283	272	274	276	271	277	285	294	275	264	246	115	136	95	89	358 20:05
30	88	75	95	99	92	92	85	92	202	274	255	269	266	279	275	261	156	96	94	88	87	93	79	95	357 11:20
31	99	101	99	92	98	95	85	101	178	269	275	277	277	275	269	275	157	95	94	95	110	72	92	96	345 20:15
32	113	114	116	118	115	117	129	145	213	259	260	265	271	271	266	272	270	155	121	175	170	125	112	112	
33	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	
34	310	304	302	311	295	296	295	303	320	315	297	295	304	292	291	293	307	295	302	301	313	308	313	309	

Total Number of Hours: 741
Monthly Average: 174

Figure 1: Example Monthly Summary: Wind Direction

A data base program, titled REPORT, has been completed which accomplishes the data reporting tasks listed above. A copy of the program is being submitted to UCD. A draft of the User's Manual for REPORT is included as Appendix I of this report. REPORT accomplishes the following tasks:

A. Reads original data from floppy disks.

Two types of data files are submitted to SJSU with the following name types YYMMDD-S.QDT and YYMMDD-S.QWN, where YY stands for year, MM for month, DD for day, and S for station. Files with the .QDT extension contain five-minute averages of data sampled at one-second intervals and the standard deviations of these data. Files with the .QWN extension contain a joint distribution of the number of observations and the average of each variable by octant of wind direction. The initial data processing step is to import the files from floppy disks into REPORT for processing. REPORT allows the operator to tag those files on the floppy disk desired for processing. Five-minute data and hourly joint distributions are imported separately.

B. Produces summaries of the data.

REPORT produces the following monthly summaries of hourly averaged data: Temperature, relative humidity, ozone concentration, east-to-west wind component (u), south-to-north wind component (v), resultant wind direction, resultant wind speed. Examples of these summaries are reproduced as Figures 1-7. REPORT also produces a monthly summary showing the distribution of average wind speed, relative humidity, temperature and ozone concentration with the octant of wind direction; this summary also shows the relative frequency distribution of the wind direction octants (Fig. 8). The third type of summary REPORT produces is the temporal listing of the five-minute averages of wind direction, wind speed, U and V components, temperature, relative humidity, and ozone concentration. A portion of the temporal listing is shown as Fig. 9.

C. Displays and prints summaries of the data.

REPORT allows the user to view and print the summaries discussed above. The "Data" option on the menu contains options for the following: (a) Display Averaged Data, (b) Display Wind Distribution, and (c) Display Combined Data. (Fig. 10). When any of these options is chosen, a screen appears listing the summaries of the chosen type which presently reside within the REPORT data base. The screen also lists the file size and the data and time of generation. See

Variable: West to East Wind Component (m/s)
 Month: October, 1991
 Location: MFM Home

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Peak	Time
01	-1.44	-1.45	-1.83	-2.10	-1.95	-1.49	-1.72	-0.58	0.35	1.46	2.16	3.03	3.09	2.68	2.92	2.61	2.18	0.59	-2.03	-1.65	-1.92	-1.75	1.72	-2.00	5.70	12:15
02	-1.94	-1.63	-1.65	-1.72	-1.66	-1.77	-1.69	-0.84	0.35	1.24	1.56	1.67	2.07	2.51	2.65	2.44	2.18	0.48	-1.67	-1.20	-1.65	-1.50	-1.65	-1.89	5.10	12:55
03	-1.76	-1.78	-1.87	-1.80	-1.54	-1.72	-1.67	-0.87	0.64	1.32	1.76	2.06	1.97	2.52	2.42	2.07	1.93	-0.10	-1.71	-1.69	-1.41	-1.52	-1.78	-1.71	5.10	13:40
04	-1.65	-1.43	-1.67	-1.67	-1.36	-1.62	-0.65	0.54	1.32	1.53	1.95	1.95	2.01	2.50	2.54	2.18	1.68	0.51	-1.19	-1.28	-1.99	-1.47	-1.79	-1.59	5.20	13:55
05	-1.85	-2.07	-1.25	-1.51	-1.54	-1.78	-1.65	-0.50	0.60	1.22	1.76	1.94	2.35	2.60	2.56	2.57	1.79	1.00	0.57	-1.00	-1.67	-1.65	-1.79	-1.59	5.70	14:55
06	-1.64	-1.79	-1.76	-1.76	-1.58	-1.72	-2.03	-1.16	0.17	0.95	1.57	1.96	1.95	2.15	2.15	1.91	1.01	1.15	1.15	-1.00	-1.67	-1.66	-1.65	-1.43	5.70	14:55
07	-1.50	-1.64	-1.65	-1.42	-1.29	-1.75	-1.94	-1.62	-0.13	0.87	2.06	2.75	3.17	3.20	3.23	2.71	1.51	1.05	1.45	-1.12	-1.57	-1.76	-1.26	-1.57	2.90	10:50
08	-1.47	-1.51	-1.22	-1.32	-1.87	-1.96	-1.38	-1.76	0.01	1.47	2.32	2.08	2.08	2.52	1.65	1.80	2.54	0.48	-1.57	-1.25	-1.57	-1.57	-1.57	-1.57	4.50	13:00
09	-1.61	-1.65	-1.53	-1.54	-1.43	-1.65	-0.72	-0.87	-0.70	0.12	0.17	0.15	1.95	2.52	1.65	1.80	1.54	0.64	-1.19	-1.25	-1.57	-1.57	-1.57	-1.57	2.80	16:00
10	-1.61	-1.40	-0.85	0.08	0.61	0.75	1.09	0.67	1.66	0.67	0.56	1.15	0.95	0.80	0.15	1.00	0.95	1.15	1.51	-1.26	-1.54	-1.45	-1.57	-1.57	2.60	14:15
11	-1.50	-1.08	-1.13	-1.20	1.62	-1.59	1.97	2.17	1.65	2.10	2.42	2.73	2.97	2.15	2.51	2.50	2.15	0.92	0.38	-1.44	-1.57	-1.57	-1.57	-1.57	5.90	13:00
12	-1.94	-1.55	-1.11	1.52	1.75	-1.36	-0.29	0.07	0.77	1.57	1.57	1.79	1.79	2.73	2.94	2.71	1.97	1.25	-1.15	-1.57	-1.57	-1.57	-1.57	-1.57	5.90	13:00
13	-1.47	-1.71	-1.65	-1.75	1.87	-1.05	-1.50	0.85	0.44	1.43	1.54	2.56	2.57	2.15	2.51	2.50	2.15	0.92	0.38	-1.44	-1.57	-1.57	-1.57	-1.57	5.90	13:00
14	-2.04	-1.74	-1.84	-1.92	-1.86	-1.85	-1.90	-1.15	-0.40	0.45	1.26	2.16	2.42	2.73	2.94	2.71	1.97	1.25	-1.15	-1.57	-1.57	-1.57	-1.57	-1.57	5.90	13:00
15	-2.00	-1.95	-1.59	-1.92	2.21	-2.45	-2.07	-1.24	0.05	1.26	1.64	2.40	2.47	2.73	2.94	2.71	1.97	1.25	-1.15	-1.57	-1.57	-1.57	-1.57	-1.57	5.90	13:00
16	-1.05	-2.10	-1.77	-1.49	1.52	-1.73	1.88	-1.35	0.77	1.56	1.64	1.91	2.47	2.73	2.94	2.71	1.97	1.25	-1.15	-1.57	-1.57	-1.57	-1.57	-1.57	5.90	13:00
17	-2.19	-1.64	-1.67	-1.50	-1.70	-1.77	-1.59	-1.50	0.05	1.07	1.50	1.79	1.79	2.73	2.94	2.71	1.97	1.25	-1.15	-1.57	-1.57	-1.57	-1.57	-1.57	5.90	13:00
18	-1.85	-1.60	-1.74	-1.65	-1.78	-1.65	-1.70	-1.10	0.15	1.17	1.38	1.57	1.57	2.73	2.94	2.71	1.97	1.25	-1.15	-1.57	-1.57	-1.57	-1.57	-1.57	5.90	13:00
19	-1.87	-1.80	-1.69	-1.89	-1.74	-1.56	-2.12	-0.60	0.22	1.55	1.45	1.77	1.80	1.70	1.97	1.00	0.00	0.57	0.52	1.05	0.95	0.95	0.95	0.95	5.90	13:00
20	-0.43	-0.97	-1.07	-1.24	-1.33	-1.17	-1.25	-1.16	0.55	0.53	1.04	1.64	1.96	2.05	2.11	1.35	0.50	0.52	0.52	0.78	0.68	1.00	1.77	-1.45	2.30	10:05
21	-1.16	-1.46	-1.64	-1.31	1.95	1.68	1.52	0.86	0.26	1.57	1.57	2.73	2.97	2.73	2.97	2.73	2.10	1.20	1.20	1.00	0.65	1.19	1.29	-1.35	1.60	13:15
22	-1.25	0.64	-0.58	-1.15	-0.50	-0.40	0.76	-0.37	0.76	1.21	1.78	2.19	2.57	2.73	2.97	2.73	2.10	1.20	1.20	1.00	0.65	1.19	1.29	-1.35	1.60	13:15
23	-1.25	1.90	1.90	2.34	2.74	2.45	2.59	2.46	2.65	2.05	1.58	2.20	2.65	2.64	2.11	2.26	2.26	1.81	0.99	0.91	0.11	0.21	0.58	-1.30	1.00	12:25
24	-1.31	0.97	-1.45	-1.93	-1.64	-0.59	0.29	0.47	0.19	1.59	1.90	1.20	2.09	2.92	2.35	1.02	1.05	0.01	-1.41	-1.52	-1.40	-1.56	-1.59	-1.53	1.10	13:15
25	-1.37	-1.40	-1.56	-1.30	-1.32	-1.22	0.18	-0.84	2.70	1.30	1.67	2.05	2.60	2.00	2.45	2.02	3.56	-1.59	-1.38	2.19	-0.98	0.05	-1.06	-0.97	5.60	08:40
26	-1.15	-1.46	-0.15	0.25	-0.59	-0.18	0.27	0.82	-	2.06	2.42	1.98	0.32	6.22	6.47	4.54	3.58	2.20	0.55	0.00	0.00	0.00	0.00	0.00	8.00	14:15
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	1.50	1.96	0.86	1.90	0.74	0.00	0.00	0.00	0.00	0.00	0.00	8.00	14:15
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	1.50	1.96	0.86	1.90	0.74	0.00	0.00	0.00	0.00	0.00	0.00	8.00	14:15
29	0.00	0.00	-0.56	-1.60	-1.71	-0.47	0.71	0.99	1.02	1.58	2.59	2.26	1.87	1.87	2.94	2.55	2.11	1.21	0.38	0.10	-0.59	0.54	1.30	-1.52	5.40	14:20
30	-1.68	-1.76	-1.85	-1.45	-1.58	-1.61	-1.21	-1.58	0.15	1.05	0.64	0.98	1.20	1.55	0.86	0.27	-0.91	-1.90	-2.01	-1.55	-1.44	-1.67	-1.35	-1.59	2.50	13:25
31	-1.64	-2.17	-1.08	-1.35	-1.95	-1.41	-1.13	-1.47	-0.29	1.12	1.57	1.85	1.96	1.86	1.64	1.49	-0.22	-1.65	-1.54	-1.51	-1.46	-0.95	-1.39	-1.54	2.50	13:40
AV	-1.33	-1.31	-1.23	-1.26	-1.31	-1.18	-1.02	-0.67	0.15	1.10	1.53	1.85	2.17	2.20	2.76	2.00	1.54	0.50	-1.15	-1.19	-1.19	-1.17	-1.35	-1.29		
N	31	31	31	31	31	31	31	31	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31		
M4	1.25	1.90	1.98	2.38	2.24	2.45	2.59	2.48	2.70	2.83	4.01	4.89	5.17	6.72	6.47	4.54	3.58	2.20	1.28	1.08	0.65	1.19	0.15	0.00		
Total Number of Hours: 743																										
Monthly Average: -0.10																										

Figure 3: Example Monthly Summary: West-to-East Wind Component

Table: Wind Speed (m/s)
 nth: October, 1991
 cation: MIN Home

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Peak	Time
1.48	1.48	1.48	1.87	2.18	1.98	1.53	1.79	0.59	0.51	1.60	2.29	3.17	3.25	2.89	3.08	2.74	2.28	0.85	2.11	1.65	2.07	1.78	1.78	2.05	3.00	11:40
2.01	1.60	1.67	1.78	1.82	1.69	1.82	1.13	0.90	0.49	1.30	1.69	1.81	2.31	2.67	2.80	2.55	2.01	0.89	1.70	1.22	1.67	1.51	1.90	1.86	3.40	14:10
1.67	1.81	1.92	1.86	1.37	1.72	1.72	1.70	0.92	0.72	1.38	1.92	2.13	2.17	2.61	2.61	2.20	2.09	1.08	1.72	1.50	1.63	1.51	1.81	1.78	3.30	13:10
1.80	1.48	1.72	1.71	1.68	1.59	1.59	1.60	0.68	0.55	1.37	1.64	2.19	2.19	2.57	2.60	2.32	1.76	0.87	1.52	1.50	2.02	1.87	1.63	1.40	3.40	13:10
1.87	2.02	1.26	1.51	1.60	1.80	1.80	1.68	0.58	0.63	1.29	1.89	2.11	2.52	2.83	2.53	2.52	1.91	0.97	1.61	1.80	1.68	1.82	1.66	1.46	3.80	13:25
1.67	1.82	1.81	1.73	1.61	1.93	2.08	1.73	1.19	0.38	1.18	1.71	1.79	2.12	2.38	2.10	1.96	1.57	1.13	1.22	1.38	1.51	1.81	1.29	1.66	3.80	13:25
1.62	1.82	1.82	1.43	1.30	1.73	1.73	1.79	1.76	1.18	1.82	2.22	2.23	2.46	2.56	2.62	2.87	1.76	1.10	1.46	1.49	1.57	1.13	2.03	1.58	3.00	10:30
1.49	1.33	1.23	1.35	1.89	2.00	1.73	1.22	1.44	1.38	1.13	2.23	2.58	2.76	1.62	1.78	2.57	2.77	1.52	1.61	1.60	1.61	1.61	1.70	4.00	16:00	
1.67	1.67	1.56	1.35	1.54	1.73	1.73	1.22	1.28	1.77	1.53	2.49	2.49	2.57	2.34	1.88	2.07	1.63	1.19	1.35	1.43	1.91	1.66	1.65	1.45	4.50	11:30
1.26	1.49	1.56	1.72	2.13	1.96	2.03	2.03	1.94	2.23	2.56	2.83	2.83	3.05	2.20	1.85	1.75	1.28	1.78	1.49	1.60	1.95	1.78	1.81	1.93	5.50	12:25
1.82	1.49	1.56	1.72	2.13	1.96	2.03	2.03	1.94	2.23	2.56	2.83	2.83	3.05	1.23	0.83	1.50	1.50	1.58	1.64	1.73	1.43	1.81	1.93	5.50	12:25	
1.97	1.56	1.13	1.13	1.81	1.40	0.52	0.52	0.57	0.65	1.67	1.83	2.00	2.65	3.70	2.58	2.73	1.17	0.95	2.22	1.63	1.43	1.81	1.93	5.50	12:25	
1.42	1.74	1.62	1.25	1.85	1.85	1.85	1.55	0.91	0.70	1.28	1.69	2.44	2.76	2.55	2.57	2.79	1.17	0.89	2.22	1.63	1.43	1.81	1.93	5.50	12:25	
2.06	1.77	1.85	1.95	1.95	1.89	1.87	1.76	1.17	0.37	0.97	1.50	2.37	2.76	2.55	2.57	2.79	1.17	0.89	2.22	1.63	1.43	1.81	1.93	5.50	12:25	
2.04	1.97	1.59	2.03	2.20	2.52	2.52	2.09	1.38	0.28	0.97	1.50	2.37	2.76	2.55	2.57	2.79	1.17	0.89	2.22	1.63	1.43	1.81	1.93	5.50	12:25	
1.90	2.73	1.81	1.53	1.53	1.76	1.76	1.91	1.37	0.37	1.45	1.75	2.44	2.76	2.55	2.57	2.79	1.17	0.89	2.22	1.63	1.43	1.81	1.93	5.50	12:25	
2.21	1.68	1.64	1.40	1.40	1.50	1.50	1.61	1.43	0.19	1.13	1.59	1.85	2.09	2.56	2.51	1.52	1.09	1.55	1.41	1.07	1.43	1.56	1.67	5.60	13:30	
1.90	1.63	1.74	1.80	1.80	1.50	1.66	1.71	1.13	0.38	1.27	1.56	1.73	2.08	2.56	2.51	1.52	1.09	1.55	1.41	1.07	1.43	1.56	1.67	5.60	13:30	
1.87	1.85	1.72	1.92	1.79	1.79	1.79	2.16	0.64	0.67	1.39	1.51	1.85	2.08	1.91	2.05	1.61	0.37	0.78	0.52	1.11	0.93	0.97	1.56	0.67	5.60	13:30
0.48	1.00	1.11	1.26	1.26	1.26	1.26	1.26	1.18	0.76	1.02	2.00	1.63	2.08	1.92	2.10	1.63	0.37	0.78	0.52	1.11	0.93	0.97	1.56	0.67	5.60	13:30
1.19	1.17	1.66	1.81	2.01	1.68	1.68	1.52	0.92	0.55	1.63	2.76	2.97	3.15	2.35	1.90	2.12	2.25	2.08	1.41	1.08	1.07	1.56	1.67	5.60	13:30	
1.25	0.80	0.70	1.17	0.99	0.68	0.68	0.79	0.42	0.74	1.37	1.88	2.51	2.54	2.35	1.90	2.12	2.25	2.08	1.41	1.08	1.07	1.56	1.67	5.60	13:30	
1.32	2.07	2.20	2.67	2.38	2.60	2.60	2.79	2.75	2.32	2.27	1.82	2.51	2.93	2.35	1.90	2.12	2.25	2.08	1.41	1.08	1.07	1.56	1.67	5.60	13:30	
1.41	1.13	1.47	1.95	1.51	0.97	0.97	1.11	0.80	0.98	1.57	2.05	1.81	2.57	2.36	1.90	2.12	2.25	2.08	1.41	1.08	1.07	1.56	1.67	5.60	13:30	
1.38	1.49	1.57	1.38	1.35	1.23	1.23	0.98	1.55	2.83	1.62	1.83	2.16	2.77	2.23	2.46	2.01	1.76	0.71	1.31	1.56	1.79	1.58	1.40	1.45	3.70	08:30
1.17	1.54	0.59	0.69	0.94	0.78	1.14	1.14	1.00	-	3.00	4.27	5.70	5.53	6.65	7.11	5.02	4.09	2.64	0.67	0.00	0.66	0.00	0.00	0.00	3.70	08:30
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.31	2.68	2.27	0.37	1.68	2.13	0.93	1.67	0.81	0.00	0.00	0.00	0.00	0.00	0.00	3.50	10:15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.71	0.98	1.32	0.74	1.41	0.76	0.26	0.86	1.80	1.37	0.00	0.00	0.00	0.00	3.50	10:15
0.00	0.00	0.58	1.71	1.79	0.73	1.13	1.13	1.26	1.11	1.67	2.49	2.33	1.93	2.19	3.13	2.73	2.23	1.38	0.61	0.60	0.61	0.55	1.35	1.55	3.70	14:20
1.72	1.81	1.89	1.51	1.62	1.25	1.61	1.25	1.61	0.95	1.21	0.76	1.08	1.31	1.66	0.89	0.31	1.06	1.93	2.05	1.60	1.48	1.68	1.36	1.62	2.60	13:25
1.68	2.21	1.92	1.38	2.00	1.43	1.50	1.16	1.50	0.56	1.15	1.67	1.97	2.10	2.05	1.74	1.58	0.74	1.68	1.39	1.34	1.53	1.13	1.43	1.59	2.60	01:10
1.46	1.49	1.43	1.50	1.54	1.34	1.45	1.45	1.14	0.89	1.53	2.05	2.27	2.45	2.57	2.51	2.21	1.71	1.21	1.42	1.38	1.29	1.33	1.39	1.35		
31	31	31	31	31	31	31	31	31	30	31	31	31	31	31	31	31	31	30	31	31	31	31	31	31		
2.21	2.23	2.20	2.67	2.38	2.60	2.60	2.79	2.73	2.83	3.00	4.27	5.28	5.53	6.65	7.11	5.02	4.09	2.64	2.27	2.32	2.07	2.38	2.08	2.14		

tal Number of Hours: 741
thly Average: 1.63

total Number of Hours: 741
 Monthly Average: 1.63

Figure 2: Example Monthly Summary: Wind Speed

Variable: Temperature (Degrees C)

Month: October, 1991

Location: MIN Hong

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Peak	Time
01	13	13	13	12	12	12	12	13	17	20	22	25	23	22	22	22	20	18	15	14	14	14	13	13	24	11:15
02	13	13	13	13	13	13	13	14	18	21	22	25	25	25	24	24	22	19	16	14	14	14	13	13	24	14:10
03	13	13	13	13	13	13	13	14	18	21	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
04	13	13	13	13	13	13	13	14	18	21	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
05	13	13	13	13	13	13	13	14	18	21	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
06	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
07	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
08	11	11	11	11	11	11	11	12	16	19	21	24	24	24	24	22	21	17	14	13	13	13	12	12	25	14:22
09	11	11	11	11	11	11	11	12	16	19	21	24	24	24	24	22	21	17	14	13	13	13	12	12	25	14:22
10	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
11	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
12	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
13	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
14	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
15	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
16	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
17	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
18	11	11	11	11	11	11	11	12	16	19	21	24	24	24	24	22	21	17	14	13	13	13	12	12	25	14:22
19	11	11	11	11	11	11	11	12	16	19	21	24	24	24	24	22	21	17	14	13	13	13	12	12	25	14:22
20	12	12	12	12	12	12	12	13	17	20	22	25	25	25	24	24	22	19	16	14	14	14	13	13	25	14:22
21	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	21	14:30
22	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	21	14:30
23	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	12	10:50
24	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	12	10:50
25	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	6	10:40
26	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	6	10:40
27	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	6	10:40
28	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	7	13:45
29	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	7	13:45
30	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	12:20
31	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	3	14:15
32	9	9	8	8	8	8	8	9	13	15	16	16	16	16	16	16	14	12	10	9	9	9	9	9	9	15:10
33	31	31	31	31	31	31	31	31	30	31	31	31	31	31	31	31	30	30	31	31	31	31	31	31	8	
34	18	18	18	18	18	18	18	18	21	23	24	25	25	24	24	24	22	21	20	18	19	10	17	18	18	

Total Number of Hours: 741
Monthly Average: 11

Figure 5: Example Monthly Summary: Temperature

Variable: South to North Wind Component (m/s)
 Month: October, 1991
 Location: MIN Home

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Peak	Time
1	0.17	0.15	0.34	0.50	0.41	0.23	0.28	0.15	0.07	-0.16	-0.15	-0.19	0.03	-0.18	-0.18	-0.01	-0.16	-0.01	0.42	0.17	0.45	0.37	0.38	0.51	0.70	18:55
2	0.51	0.27	0.28	0.39	0.25	0.29	0.03	0.24	0.03	-0.02	-0.19	-0.13	-0.00	-0.07	-0.13	-0.15	0.26	0.06	0.28	-0.03	0.27	0.17	0.30	0.20	1.00	12:25
3	0.26	0.27	0.33	0.37	0.10	0.25	0.25	0.14	0.01	-0.10	-0.34	-0.08	0.16	-0.14	-0.12	-0.17	-0.21	-0.07	0.17	0.17	0.11	0.18	0.28	0.27	0.80	12:20
4	0.24	0.13	0.39	0.28	0.22	0.13	0.30	0.14	0.01	-0.23	-0.12	-0.21	0.11	0.12	-0.18	0.02	0.04	0.05	0.12	0.11	0.32	0.20	0.22	0.14	0.90	14:05
5	0.22	0.37	0.04	0.13	0.18	0.28	0.20	0.07	0.04	0.01	-0.23	-0.03	-0.16	0.30	-0.09	0.10	-0.18	0.10	0.19	0.24	0.21	0.24	0.18	0.07	0.60	14:05
6	0.19	0.23	0.31	0.24	0.19	0.30	0.33	0.18	0.19	-0.08	-0.15	-0.25	0.55	0.04	0.02	0.09	0.16	0.23	0.09	0.09	0.08	0.11	0.21	0.90	08:35	
7	0.16	0.40	0.29	0.03	0.06	0.25	0.38	0.38	0.72	-0.67	-0.23	-0.19	-0.22	0.53	0.58	0.97	0.09	0.13	0.08	0.07	0.16	0.14	0.36	0.15	2.10	09:15
8	0.13	0.00	0.04	0.05	0.24	0.29	0.23	0.13	0.33	0.37	-0.04	-0.51	-0.23	0.24	0.44	-0.08	-0.58	0.09	0.03	0.03	-0.23	-0.21	-0.27	-0.06	1.80	10:25
9	-0.13	-0.25	-0.11	0.01	0.11	0.28	0.02	0.20	0.95	0.23	1.28	1.09	-0.23	0.17	0.01	0.25	-0.07	0.02	0.21	-0.24	0.21	0.37	0.20	-0.03	4.00	11:50
10	-0.11	-0.07	0.10	-0.23	0.14	0.17	-0.05	0.15	0.42	0.12	1.95	2.15	1.10	0.60	0.20	0.17	0.13	0.23	0.17	-0.62	0.74	0.58	0.54	-0.32	2.70	12:35
11	-0.33	-0.44	-0.41	-0.39	-0.15	-0.15	-0.51	-0.25	0.45	1.02	0.76	0.56	-0.55	-0.56	0.49	0.52	0.49	0.15	0.06	0.25	-0.02	0.12	0.09	0.11	2.50	10:50
12	0.13	0.18	0.03	0.05	0.30	0.19	0.07	0.03	-0.08	-0.01	-0.08	0.22	-0.63	-0.20	-0.02	0.23	0.35	0.17	0.25	0.18	0.27	0.04	0.33	0.15	1.30	16:15
13	0.11	0.27	0.16	0.05	0.15	-0.08	-0.09	0.00	0.04	-0.15	0.70	-0.02	0.05	-0.13	0.17	0.14	-0.50	0.08	0.30	0.41	0.27	0.19	0.33	0.15	1.30	16:15
14	0.36	0.30	0.18	0.29	0.24	0.28	0.41	0.23	0.04	-0.10	0.16	0.05	0.01	-0.13	0.17	0.14	-0.50	0.08	0.30	0.41	0.27	0.19	0.33	0.15	1.30	16:15
15	0.35	0.27	0.04	0.33	0.41	0.56	0.33	0.25	0.13	-0.02	-0.09	0.02	0.04	0.31	0.14	0.23	0.04	0.17	0.18	0.06	0.13	0.15	0.21	0.20	0.70	06:00
16	0.26	0.32	0.24	0.18	0.16	0.21	0.25	0.26	0.00	-0.24	0.16	0.09	0.11	0.05	0.01	0.17	0.03	0.01	0.27	0.07	0.15	0.07	0.15	0.04	0.80	05:10
17	0.39	0.21	0.17	0.09	0.23	0.12	0.18	0.33	0.05	-0.12	0.08	0.00	0.11	0.04	-0.05	0.03	0.04	0.04	0.04	0.18	0.18	0.16	0.29	0.15	0.70	00:05
18	0.31	0.26	0.28	0.37	0.11	0.20	0.24	0.24	0.77	0.03	-0.20	-0.03	0.00	0.04	-0.05	0.03	0.04	0.04	0.04	0.21	0.19	0.14	0.17	0.00	5.30	15:55
19	0.23	0.36	0.18	0.22	0.29	0.08	0.38	0.07	0.27	-0.19	-0.03	-0.07	-0.18	0.15	0.63	0.13	0.04	0.08	0.04	0.21	0.19	0.14	0.17	0.00	1.30	07:15
20	-0.11	-0.14	-0.17	-0.03	-0.13	-0.15	0.05	0.26	0.23	-0.11	0.05	-0.08	-0.08	0.08	-0.09	0.51	0.02	0.01	0.05	0.08	0.09	0.18	0.13	0.00	5.30	15:55
21	0.05	0.01	0.19	0.17	0.33	0.21	0.15	0.12	0.28	0.02	-0.33	-0.23	-0.29	0.48	-0.05	0.03	0.03	0.01	0.07	0.10	-0.09	0.03	0.03	0.03	1.30	07:15
22	0.07	0.07	0.17	0.09	-0.11	-0.35	0.05	0.15	0.01	-0.14	0.13	-0.38	0.07	-0.28	-0.58	-0.44	0.31	-0.05	0.07	0.10	-0.09	0.03	0.03	0.03	0.70	07:15
23	-0.29	-0.65	-0.73	1.00	-0.60	-0.58	-0.76	0.69	0.74	-0.63	0.48	-0.63	0.54	-0.69	0.55	0.79	0.71	0.30	0.26	0.30	-0.09	0.18	0.21	-0.13	0.40	12:10
24	0.05	-0.27	-0.04	0.19	-0.23	-0.29	-0.57	0.23	0.38	-0.14	0.13	0.19	0.07	0.26	-0.51	-0.27	0.50	0.13	0.09	0.12	0.08	0.17	0.03	0.13	1.50	11:40
25	0.05	0.22	-0.14	-0.19	0.13	-0.19	-0.56	-0.40	-	-0.73	-0.65	-0.97	-1.09	0.26	-0.02	-0.07	-0.03	0.26	0.10	0.29	0.05	-0.07	0.05	0.06	1.00	07:20
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.80	-0.85	-0.88	-1.17	-1.10	-1.18	-1.32	-1.48	-1.02	-0.29	0.00	0.00	0.00	0.00	0.00	0.60	05:25
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.24	-0.08	-0.32	-0.55	-0.59	-0.26	-0.58	-0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	00:05
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.24	-0.08	-0.32	-0.12	-0.33	-0.27	-0.10	-0.45	0.06	0.05	0.00	0.00	0.00	0.00	0.40	11:25
29	0.00	0.00	-0.01	0.08	0.27	-0.03	-0.37	0.39	0.23	-0.27	-0.09	-0.17	-0.23	-0.75	-0.38	-0.60	-0.48	-0.53	-0.18	-0.24	0.02	0.00	0.15	0.00	0.70	04:45
30	0.02	0.17	0.21	0.06	0.09	0.08	-0.02	0.11	0.05	0.12	-0.08	-0.25	-0.30	-0.30	-0.06	0.00	0.34	0.22	0.18	0.01	-0.05	0.08	-0.13	0.11	0.80	08:15
31	0.26	0.42	0.33	0.09	0.28	0.08	-0.08	0.29	0.29	0.01	-0.13	-0.23	-0.27	-0.20	-0.03	-0.17	0.14	0.17	0.13	0.16	0.07	-0.13	0.12	0.27	0.90	08:20
AV	0.12	0.10	0.08	0.08	0.12	0.09	0.03	0.08	0.12	-0.06	-0.01	-0.04	0.13	-0.21	-0.16	-0.21	-0.18	-0.04	0.06	0.06	0.08	0.10	0.11	0.09		
N	31	31	31	31	31	31	31	31	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31		
M	0.51	0.42	0.34	0.50	0.41	0.56	0.41	0.57	0.95	1.02	1.95	2.15	1.10	0.60	0.49	0.51	0.35	0.27	0.42	0.41	0.43	0.49	0.38	0.51		

Total Number of Hours: 743
 Monthly Average: 0.01

Figure 4: Example Monthly Summary: South-to-North Wind Component

Variable: Ozone Concentration (ppbv)
 Month: October, 1991
 Location: Min Home

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Peak	Time	
01	55	57	55	52	51	48	45	42	51	64	65	70	85	102	108	111	109	100	76	100	75	75	75	70	112	15:15	
02	68	67	67	64	62	58	58	54	59	77	84	89	90	85	75	79	100	99	59	98	97	95	65	59	90	15:00	
03	57	58	57	53	55	55	49	43	53	68	70	85	92	101	105	107	109	106	86	85	73	58	65	75	114	16:40	
04	73	73	71	71	67	59	53	53	60	86	91	96	102	110	116	117	116	85	85	83	67	60	62	62	124	13:50	
05	64	65	63	61	71	69	62	62	72	99	102	106	114	124	130	123	120	95	91	91	91	91	84	87	131	11:25	
06	68	68	74	66	79	86	81	82	82	99	90	92	98	107	112	115	115	76	75	73	75	75	70	68	124	15:10	
07	74	70	48	63	63	64	63	62	57	59	60	64	68	57	62	62	66	51	51	51	47	47	47	47	70	70:00	
08	50	50	48	48	48	46	44	44	50	51	52	56	58	65	64	61	66	52	52	52	52	50	46	46	16	68:30	
09	45	44	44	43	43	41	42	44	44	52	56	57	54	74	91	100	93	65	54	50	53	50	50	52	68	13:30	
10	50	53	54	52	51	46	44	49	54	55	58	54	60	65	70	89	88	77	61	55	52	51	52	54	105	14:10	
11	57	55	55	55	57	59	57	59	59	60	60	67	61	64	65	63	67	57	57	55	56	48	48	54	72	13:50	
12	51	50	49	46	44	43	40	41	44	45	44	43	41	44	49	47	43	39	39	34	39	47	50	54	83	16:00	
13	52	50	51	50	47	48	49	45	45	56	63	60	61	64	69	71	69	57	57	50	49	47	52	52	93	16:30	
14	55	52	52	49	46	42	42	40	40	50	54	55	65	55	53	53	53	40	40	35	37	36	41	60	93	16:30	
15	45	45	44	40	40	40	40	39	40	50	54	55	65	55	53	53	53	40	40	35	37	36	41	60	93	16:30	
16	44	45	44	40	40	40	40	39	40	50	54	55	65	55	53	53	53	40	40	35	37	36	41	60	93	16:30	
17	50	50	50	48	46	45	40	40	40	50	54	55	65	55	53	53	53	40	40	35	37	36	41	60	93	16:30	
18	74	74	82	83	83	69	66	64	40	55	60	66	74	111	120	120	117	93	98	76	67	63	48	66	137	15:00	
19	56	40	35	40	36	35	36	34	34	47	68	80	104	105	112	121	97	52	66	67	63	57	60	55	124	15:50	
20	27	25	25	25	25	25	25	25	26	33	37	40	42	43	43	43	43	40	40	37	33	30	31	36	52	15:50	
21	31	32	36	35	35	30	30	29	30	39	41	42	45	43	43	43	43	40	40	37	33	30	31	36	52	15:50	
22	19	17	17	17	17	19	18	18	22	24	26	27	29	30	32	33	33	41	43	35	29	23	21	19	45	16:00	
23	10	12	15	15	15	15	17	11	11	25	29	31	35	34	31	33	33	41	43	35	29	23	21	19	45	16:00	
24	20	19	18	19	18	16	17	21	21	35	39	40	43	44	44	43	43	40	40	37	33	30	31	36	52	16:50	
25	43	41	41	38	38	37	37	36	34	36	39	37	36	34	31	33	33	41	43	35	29	23	21	19	45	16:50	
26	34	34	37	34	33	32	26	26	24	25	30	34	35	33	37	39	39	41	43	35	29	23	21	19	45	16:50	
27	35	34	35	36	34	27	21	18	27	37	37	38	40	47	47	48	48	40	40	37	33	30	31	36	52	16:50	
28	18	19	21	22	22	23	24	23	24	33	31	30	41	41	40	29	26	40	40	37	33	30	31	36	52	16:50	
29	28	29	27	29	30	31	32	32	29	30	50	40	50	52	50	40	20	26	29	31	30	31	36	52	55	10:15	
30	47	46	45	45	45	43	41	39	43	52	57	62	66	70	74	77	71	54	54	49	47	46	47	45	45	55	10:15
31	31	31	31	31	31	30	30	31	30	31	51	51	51	51	51	51	50	30	30	31	31	31	31	31	31	55	10:15
32	88	84	82	86	79	86	81	66	72	99	102	106	110	124	130	135	120	93	98	94	94	94	85	87	87	87	87

Total Number of Hours: 739

Total Number of Hours: 739
 Monthly Average: 53

Figure 7: Example Monthly Summary: Ozone Concentration

Variable: Relative Humidity (%)
 Month: October, 1991
 Location: MIN Home

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Peak	Time	
01	66	68	68	68	67	65	66	68	54	47	43	42	45	46	46	46	50	58	67	70	69	69	71	79	72	25	
02	69	70	71	71	72	71	71	74	58	48	46	45	41	45	47	47	46	49	49	50	48	47	53	52	74	07:10	
03	51	51	53	53	54	55	55	60	49	39	41	41	42	43	47	47	46	50	65	60	59	67	60	62	64	10:20	
04	60	62	62	62	64	63	62	64	55	47	44	43	43	45	47	41	45	55	63	51	49	48	40	49	63	03:45	
05	51	52	51	52	56	57	55	60	51	45	44	43	45	46	45	45	47	57	65	65	67	65	64	64	67	03:10	
06	66	66	66	63	62	68	68	62	51	39	41	41	45	46	45	45	47	57	65	65	67	65	64	64	67	03:10	
07	45	44	43	43	45	43	43	48	44	39	29	27	28	31	31	31	34	37	44	47	43	42	42	41	70	09:30	
08	47	47	47	48	48	47	46	52	47	28	25	26	27	28	33	32	34	37	44	44	44	43	43	45	45	10:00	
09	41	41	45	46	46	43	41	40	32	24	21	23	23	25	33	32	34	37	44	29	25	43	43	43	52	07:20	
10	26	24	27	31	29	34	38	32	24	22	19	13	13	15	22	21	26	37	43	34	29	25	27	27	37	17:00	
11	25	25	25	25	25	26	27	29	26	25	25	29	33	35	34	34	33	45	46	44	43	25	26	26	30	06:30	
12	49	48	48	47	49	49	49	51	43	34	35	36	34	38	48	49	47	59	63	63	63	63	63	63	50	7	
13	59	60	58	54	52	49	48	44	47	30	35	36	34	38	48	49	47	59	63	63	63	63	63	63	50	7	
14	47	46	45	44	43	44	44	44	47	30	35	36	34	38	48	49	47	59	63	63	63	63	63	63	50	7	
15	41	40	39	38	36	35	35	40	34	27	23	22	22	24	31	31	31	37	49	45	45	45	45	45	51	04:50	
16	53	53	53	53	54	55	56	56	51	42	38	37	37	38	48	49	47	59	63	63	63	63	63	63	51	04:50	
17	48	42	41	43	46	43	41	41	46	32	35	34	35	38	48	49	47	59	63	63	63	63	63	63	51	04:50	
18	63	61	62	68	64	63	60	56	51	46	52	54	55	53	43	43	43	57	62	57	52	52	61	60	66	10:00	
19	49	42	38	40	38	39	39	44	41	31	35	45	45	45	47	47	47	47	47	40	47	49	45	43	69	03:12	
20	39	37	37	37	37	37	39	43	39	27	27	25	25	25	43	43	43	43	43	45	45	45	45	41	57	13:11	
21	43	45	47	50	47	44	42	40	42	33	35	32	32	33	43	43	43	43	43	45	45	45	45	41	57	13:11	
22	62	61	70	71	73	75	76	76	65	62	64	71	77	80	77	77	77	80	85	90	90	95	95	95	100	10:00	
23	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10:00
24	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10:00
25	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	10:00
26	96	95	94	94	94	94	94	94	92	87	79	73	71	69	69	69	69	69	69	91	97	95	94	97	100	00:05	
27	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	00:05
28	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	00:05
29	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	00:05
30	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	00:05
31	100	100	100	100	96	94	91	88	83	45	37	52	51	54	58	67	81	90	89	83	87	86	87	85	100	00:05	
AV	64	64	64	64	64	64	64	65	58	51	51	51	52	53	54	55	59	64	66	64	67	64	64	64	64	64	
N	31	31	31	31	31	31	31	31	30	31	31	31	31	31	31	31	30	30	31	31	31	31	31	31	31	31	
PM	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

Total Number of Hours: 741

Total Number of Hours: 741
 Monthly Average: 60

Figure 6: Example Monthly Summary: Relative Humidity

Fig. 11 for an example. The user then has the option of viewing the file on the terminal screen or printing the file to paper.

D. Stores the summaries on hard disk for final exporting to floppy disks for archival.

REPORT transports the completed summaries to a subdirectory named \OUT. From there they can be down loaded to floppy disks for archival.

3.1 Tasks Left Undone

During final evaluation of the results from REPORT, some inaccuracies were discovered. In the first case, the Quality Control Word (QCW) from the data disks supplied by UCD contain blanks instead of zeros when no known data problems occur. This discovery required a revision of the program logic in order to remove suspect data. In the second case, we discovered that the algorithm to compute resultant wind vectors from the average U and V components was in error. Both of these errors are in the process of being corrected.

4. EPISODE ANALYSIS

We have identified two periods during the summer of 1991 for which Sacramento and/or San Joaquin County monitoring stations recorded ozone concentrations above the State standards. These periods are July 10-11 and July 21-31. The first period coincided with the quality assurance audits conducted by SJSU during which there were a number of stations with ozone monitor malfunctions. Therefore little attention was paid to this episode. Table 1 shows the local AQMD stations with state ozone excesses for the July 21-31 period.

Data Summaries Batch Utilities Help

D:\MACKAY\OUT\AU91-03.DAT

Dir	% Frequency of Dir	Average So (m/s)	Average RH (%)	Average T (Deg C)	Average O3 (ppbv)
00	9.62	0.00	36	20.03	86
01	1.68	0.86	39	18.24	91
02	2.06	1.06	36	21.87	108
03	10.36	1.02	39	20.95	124
04	20.22	1.41	35	22.75	128
05	10.10	1.39	32	24.07	120
06	4.52	1.06	33	23.87	104
07	22.06	1.28	48	16.26	96
08	19.37	1.11	46	16.50	97
Total = 100.00					

Figure 8: Example Summary of Parameters by Wind Direction

Data Summaries Batch Utilities Help

D:\MACKAY\OUT\AU91-04.DAT

Month: August, 1991

Location: 5-Mile

Time	Dir (Deg)	Average					
		So (m/s)	U (m/s)	V (m/s)	T (Deg C)	RH (%)	O3 (ppbv)
01.00	133	0.82	-0.58	0.52	21	37	86
01.04	119	0.26	-0.19	0.13	21	36	84
01.08	97	0.31	-0.23	0.11	21	38	89
01.12	121	0.42	-0.23	0.23	21	40	90
01.17	163	0.11	-0.02	0.07	20	43	90
01.21	66	0.03	-0.02	0.03	20	45	86
01.25	165	0.31	-0.05	0.28	20	49	78
01.29	177	1.58	-0.02	1.48	22	46	76
01.33	201	1.76	0.36	1.41	24	42	77
01.38	196	1.77	0.35	1.43	26	39	80
01.42	188	2.13	0.13	1.87	26	36	76

Figure 9: Example Temporal Listing of Five-Minute Averages

Table 1: July 21-31 State Ozone (pphm) Excesses by Region (From CEPA/ARB 1991)

DATE	SACRAMENTO VALLEY		SAN JOAQUIN VALLEY	
	Loc.	Max.	Loc.	Max.
----	-----		-----	
7/21	Folsom	11	Arvin	10
7/22	Auburn	11	Frenso-1st	13
	Rocklin	10	Fresno-Dmm	10
	Folsom	10	Parlier	13
			Arvin	11
			Edison	13
			Stktn-E.Mn	10
			Modesto	10
			Visalia	10
7/23	Auburn	10	Fresno-1st	10
	Redding	10	Parlier	10
			Arvin	11
			Edison	12
			Visalia	10
7/24	Auburn	10	Arvin	10
	Redding	10	Edison	10
7/25	Rocklin	10		
	CitrusHts	11		
	Folsom	12		
	Del Paso	11		
7/26	Auburn	12	Fresno-1st	10
	Rocklin	11	Arvin	12
	CitrusHt	10	Edison	11
	Folsom	10	Stktn-E Mn	10
			Visalia	11
7/27	Auburn	13	Clovis	11
	Rocklin	11	Fresno-1st	11
			Arvin	12
			B'ksrfld	10
			Edison	11
			Maricopa	10
			Shafter	10
			Madera	10
			Stktn-E Mn	10
			Modesto	10
			Turlock	10

Data	Summaries	Batch	Utilities	Help
Load 5 Min Data...				
Load Hourly Data...				
Display Averaged Data...				
Display Wind Distribution...				
Display Combined Data...				
Restore Data Base...				
Quit				

Figure 10: Screen of Menu Choice 'Data'

Data	Summaries	Batch	Utilities	Help
Summaries of Averaged Data				
SAU91-03.DTR	5713	06-25-92	11:26:30	
SAU91-03.SP	5705	06-25-92	11:26:30	
SAU91-03.H	5722	06-25-92	11:26:30	
SAU91-03.V	5724	06-25-92	11:26:30	
SAU91-03.T	5712	06-25-92	11:26:32	
SAU91-03.PH	5710	06-25-92	11:26:32	
SAU91-03.O3	5715	06-25-92	11:26:32	
SAU91-04.DTR	5709	06-26-92	09:30:26	
SAU91-04.SP	5701	06-26-92	09:30:28	
SAU91-04.H	5718	06-26-92	09:30:28	
SAU91-04.V	5720	06-26-92	09:30:28	
SAU91-04.T	5708	06-26-92	09:30:30	
SAU91-04.PH	5706	06-26-92	09:30:30	
SAU91-04.O3	5711	06-26-92	09:30:30	
Return View P Print Esc Cancel				

Figure 11: Screen of Menu Choice 'Data/Summaries of Averaged Data'

Table 2 shows the high hour ozone for the SCOIAS stations along with the time of the high hour.

 Table 2: High hour Ozone Concentrations (ppb) for SCOIAS Observations, July 21-31, 1991. (Time of High Hour)

Day	Wt Cloud	Sly Pk	5-Mile	J'dale	Shaver L.	Mt. Home
21	71(15)	68(15)	75(15,16, 20,21)	73(19)	--	104(17)
22	83(14)	88(16)	89(16)	78(20,21)	--	101(16)
23	100(19)	83(11)	88(12)	80(14,15)	--	123(17)
24	98(20,21)	76(10)	80(9,10)	68(10,12, 13,22)	77(16)*	112(18)
25	86(13)	70(15,16)	83(16)	68(21,23)	92(15)	83(11)*
26	117(19)	80(15)	96(22)	96(18)	113(17)	--
27	93(20)	93(14)	105(20)	91(14)	130(17)	--
28	104(02)	80(11-13)	101(00, 02,03)	90(13)	122(17)	--
29	96(15)	71(10,15)	92(12)	83(14,15)	136(16)	--
30	108(21)	115(17)	90(20)	88(14)	142(17)	--
31	95(05)	80(16)	89(21)	94(12)	117(17)	--

* - Incomplete data for day

 On 1 August, one Kern Co station (Arvin) recorded 10 pphm.

We have identified and acquired the following data for the period:

From the ARB: Temperature soundings for Columbia (19-31), Salinas (24,25), Sacramento (27,28,30,31). Aircraft soundings at Reed Bluff, Ukiah, Thermal, Sacramento, LPT, Modesto, Fresno, Salinas, Bakersfield. Radiosonde Skew-t plots for Vandenberg AFB, Medford OR, Oakland, San Diego, Edwards AFB, San Nicolas Island, and Point Hueneme. Hourly pollutant concentrations for ARB reporting stations.

From the National Climatic Data Center: Hourly surface observations (SA's) for Visalia, Fresno, Bakersfield, Sacramento, Stockton. Detailed rawinsonde observations for Oakland.

Table 1 Continued:

7/28	Auburn	12	Fresno-1st	10
	Redding	10	Arvin	12
	Red Bluff	10	B'ksrflld	10
			Edison	11
			Maricopa	10
			Stktn-E Mn	10
			Modesto	10
7/29	Auburn	10	Parlier	10
	Rocklin	13	Arvin	11
	CitrusHts	15	Bksrflld	11
	Folsom	14	Edison	13
	N. H'Lnds	10	Maricopa	10
	Del Paso	15	Oildale	10
	Sac-T St	10	Stktn-Hztn	10
	Red Bluff	10	Stktn-E Mn	11
	Woodland	10	Modesto	11
			Turlock	10
7/30	Willows	10	Fresno-1st	14
	Auburn	10	Fresno-Dmm	10
	Rocklin	11	Parlier	13
	Citrus Ht	13	Arvin	16
	Del Paso	18	Bksrflld	11
	Sac-T St	14	Edison	14
	Plsnt Gv	10	Maricopa	10
	Yuba City	10	Oildale	11
	Davis	10	Shafter	10
	Woodland	10	Stktn-E Mn	11
			Modesto	11
			Turlock	11
7/31			Fresno-Sky	10
			Fresno-1st	11
			Parlier	10
			Arvin	11
			Edison	11
			Maricopa	10
			Oildale	10
			Madera	10

APPENDIX I: DRAFT USER'S MANUAL FOR PROGRAM REPORT

by

Iacovos G.Molodanof

Edits: 02/01/92 igm
23/02/92 igm Changed Way Of Report Selection
22/04/92 igm Fixed Bug. Had to Change the order of the
Fields in the Data Base.
08/06/92 igm Added text description for location codes.
08/06/92 igm Added Calibration corrections.
08/06/92 igm Data files can now be deleted to save space.

PREFACE

REPORT is designed to read archived data and create and/or display three types of summaries using the data collected under agreement A032-129. The three types of summaries are:

1. Monthly printed summaries of hourly averaged data.
2. Monthly printed summaries of event distribution by wind direction.
3. Temporally ordered hourly averaged data for each variable for each station and each month.

and the two types of data files that REPORT uses as input are:

1. Archived Five Minute Files (.QDT)
2. Archived Hourly Event Data (.QWN)

The program is menu driven. The <Up/Down/Left/Right> arrows on the IBM PC/AT keyboard are used to position the selection bar and the <Return> key is used to select the next menu from the available choices. If there is no next menu choice then the actual option will be executed. The <Escape> key is used to abort a selected action and return the user to the previous selection.

REPORT is written in Turbo Pascal Version 5.5. Some sections of the code are written in assembly language for speed purposes.

SYSTEM REQUIREMENTS

REPORT will run on any family of PC/AT personal computers with a hard disk and a 3.5 1.44Mb floppy drive. Although the program will run on any Intel 00x86 family of processors with or without a CoProcessor, a 286 or better with a 287 CoProcessor and a fast Hard Disk are highly recommended. Color display is not required, as the program does not make use of color.

INSTALLATION

1. Insert the Program Disk in floppy drive A or B.
2. Change the current drive by typing A: or B: in the DOS prompt and hit <Return>
3. Type INSTALL and then hit <Return>.

The Installation program will load and display a logo. Press any key to continue. An Input Form will be displayed to aid the user to change some default options. Use the <Up/Down/Left/Right> keys to move to cursor and type over on any option needed to be changed. Press Function Key F9 to Continue the Installation or <Escape>, to Abort.

The Installation options are:

- a. Source Drive. Defaults to the current drive. Change if needed.
- b. Destination Drive. The Hard Disk drive letter. Defaults to C but can be changed if needed.
- c. Base Directory. The directory name that the REPORT program will reside. Defaults to MACKAY but it can be changed.

NOTE: DO NOT attempt to install the program by simply copying all files to the Hard Disk. The Installation Program creates a special CFG file used for the proper function of the REPORT program. Without the above file the program will NOT FUNCTION PROPERLY and data MAY BE LOST.

PROGRAM OPERATION

In order to create any summaries, the program must first read the archived files in its own data base. After that, any number of summaries can be produced without the need to re-read the archived files. Throughout this document there will be a reference to some keywords in quotes, such as:

'Data Base'. Groups of files in which the archived files are read into. REPORT is using two data bases, one for the Five minute data and one for the Hourly data.

'Input Path'. Input Path is the location of the archived files. Most of the time the Input Path will be 'A:\' or 'B:\', specifying that the data will be on a floppy disk. It can also specify a Hard disk such as 'C:\DATA\' or even a Network Drive.

'Output Path'. The location of all summaries that the program creates.

'System Path'. The location of the 'data bases' and special control files.

The user can activate REPORT by typing REPORT at the directory that the program resides and hitting <Return>. If the current directory is other than the program's directory, use the DOS CD command to change it.

MENU OPTIONS

When REPORT starts it displays a Pull Down Menu with the following options:

1. Data

1.1 Load 5 Min Data

Before any Averaged Data summaries can be created, the user has to select this option. When the user selects this option, a panel will be displayed with all Five Minute Data (.QDT) existing in the 'Input Path'. Use the <Space Bar> to Select And/Or DeSelect each file. Use 'A' to Select And/Or DeSelect All Files. Pressing the <Return> key the program will transfer the selected data into it's own DataBase. After the completion of the transfer, the user can now create Averaged Data summaries.

1.2 Load Hourly Data

Before any Hourly Data summaries can be created, the user has to select this option. When the user selects this option, a panel will be displayed with all Hourly Data (.QWN) existing in the 'Input Path'. Use the <Space Bar> to Select And/Or DeSelect each file. Use 'A' to Select And/Or DeSelect All Files. Pressing the <Return> key the program will transfer the selected data into it's own DataBase. After the completion of the transfer, the user can now create Averaged Data summaries.

1.3 Display Averaged Data

Use this option to display a list of all Averaged Data Summaries that are existing in the 'Output Path'. Use the <Return> key to view them or the 'P' key to make a hard copy.

1.4 Display Wind Distribution

Use this option to display a list of all Wind Distribution Summaries that are existing in the 'Output Path'. Use the <Return> key to view them or the 'P' key to make a hard copy.

1.5 Display Combined Data

Use this option to display a list of all Ordered Hourly Averaged data for each variable, that are existing in the 'Output Path'. Use the <Return> key to view them or the 'P' key to make a hard copy.

1.6 Quit

Use this Option to Quit the Program and return to DOS.

2. Summaries

2.1 Summaries of Averaged Data

This option will create the actual summaries of Five Minute Data. Two sets of summaries will be created. The first set will be Monthly summaries of averaged data for each variable.

Files:

5mmyy-11.Dir	Wind Direction
5mmyy-11.Sp	Wind Speed
5mmyy-11.o3	Ozone
5mmyy-11.u	U Component
5mmyy-11.v	V Component
5mmyy-11.rh	Relative Humidity
5mmyy-11.t	Temperature

where mm is Month, yy is Year and ll is Station Location.

The other set of summaries will be Temporally Ordered Hourly Averaged Data for each variable.

Files:

mmyy-11.dat

where mm is Month, yy is Year and ll is Station Location.

2.2 Summaries of Wind Distribution

This option will create monthly summaries of event distribution by wind direction.

Files:

mmyy-11.daw

where mm is Month, yy is Year and ll is Station Location.

3. Batch Summaries

3.1 Summaries of Averaged Data

This option combines option 1.1 and option 2.1. Since loading of the data files can take quite a while (especially in a slow machine), the user can select this option, select the files to be loaded and then leave the program unattended. All

the summaries for the Five Minute Data will be created. (see Menu Option 2.1)

3.2 Summaries of Wind Distribution

This option combines option 1.2 and option 2.2. Since loading of the data files can take quite a while (especially in a slow machine), the user can select this option, select the files to be loaded and then leave the program unattended. All the summaries for the Hourly Data will be created. (see Menu Option 2.2)

4. Utilities

4.1 Setup

Use this option to change the 'Input Path'. You can also change the 'System Path' the 'Output Path' and the 'Temporary Path' but it is not recommended.

5. Help

5.1 Help File

Use this option to display this document.

5.2 About

Use this option to display the program's logo and copyright notices.

SAMPLE PROGRAM RUN

Creating Summaries of Five Minute Data:

1. Run REPORT

- a. Change to the directory where the REPORT program resides.
- b. Type 'REPORT' and then press the <Return> key.

2. Insert Diskette with Data in Drive A or B

3. Using the REPORT 'Utilities' menu option, make sure

that the 'Input Path' is 'A:\' or 'B:\'.

- a. Use 'Utilities' Menu Option (4.1) to change the 'Input Path' if other than 'A:\' or 'B:\'.

4. Use 'Batch' Menu Option (3.1)

The Five Minute summaries of the Data will be created. Use Menu Option 1.3 and 1.5 to Display them And/Or print them.

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ASSET

REPORT DOCUMENTATION PAGE

1. AGENCY USE ONLY (Leave Blank) PB93-210292		2. REPORT DATE June 1992		3. REPORT TYPE AND DATES COVERED Final Report June 1991 to June 1992	
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12a. DISTRIBUTION/AVAILABILITY STATEMENT Release unlimited. Available from National Technical Information Service. 5285 Port Royal Road Springfield, VA 22161				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 Words) The Purpose of the Sierra Cooperative Ozone Impact Assessment Study is to monitor the degree to which pine species in Sierran forests are exposed to ozone. This report documents the ozone and meteorological data collected during Year 2 (June 1991 to June 1992). The major tasks were the continued operation of five stations established in 1990, and the installation of a sixth site--Shaver Lake in the Sierra National Forest (NF); Five-Mile (Stanislaus NF); Sly Park (Eldorado NF); and White Cloud (Tahoe NF). Data are collected from about 15 April to 15 October each year. Target goals for data collection (80 percent) were achieved at all but one site, where instrument problems contributed to a data void of 22 percent. Ozone levels typically peak in the afternoon and tend to be higher at the southern stations. In June-September, hourly average ozone concentrations exceeded 60 ppbv at all sites, and were in excess of 80 ppbv at most sites on about 50 percent of the sampling days. At the most heavily exposed site, Mountain Home, ozone concentrations in excess of 100 ppbv were reached on nearly half of the days in the June-September period.					
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